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REGIONAL VETERINARY SURGERY AND OPERATIVE TECHNIQUE

(INCORPORATING PROF. DR. H. MÖLLER'S
"VETERINARY SURGERY.")

BY

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ITALIAN SOCIETY OF HYGIENE, ETC.

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- "Operationslehre," J. Bayer.
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- "The Veterinarian."
- "The Veterinary Journal."
- "The Veterinary Record."
- "Traité de Thérapeutique chirurgicale," Cadiot and Almy.
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- "Médecine Canine," Cadiot and Breton.
- "Diseases of Cattle, Sheep, Goats and Swine," Moussu and Dollar.

PREFACE.

SEVENTEEN years ago I published my first serious contribution to veterinary literature, an edited translation of Professor Möller's "Veterinary Surgery." So far did the approval of the veterinary profession exceed my modest anticipations that the issue was exhausted before I could prepare a second and, for a few months, the book was out of print. Volume followed volume, but after the appearance of "Operative Technique" (1902), "Regional Surgery" (1903), and "Diseases of Cattle" (1905), it became increasingly evident that the labour of preparing fresh editions must eventually outgrow the powers of a busy veterinary practitioner, especially as each new edition calls not merely for revision but for a careful study of all the most noteworthy advances announced in veterinary literature, British, American and Continental, since the appearance of its predecessor. In producing the present volume, therefore, I have been only too glad to avail myself of the kind assistance of my friend and ever-willing helper, Professor McQueen, without whom the task could certainly not have been brought to completion: to him I have the pleasure of expressing my deep obligation and my no less earnest thanks.

The work now before the reader includes the main principles of a scheme originally more ambitious. For three volumes dealing respectively with Operative Technique, Regional and General Surgery, we have substituted one. In this have been retained all the chief features of the two first mentioned. By judicious editing and the use of suitable type, it has also proved possible to include within the

limits of the book a great part of what had been destined for a third volume on General Surgery. Modern requirements demand not only great compression in material but moderate bulk and cost of production. In endeavouring to combine all these, no essential feature has been sacrificed, and it is earnestly hoped that this latest venture may receive at the hands of the veterinary profession no less favourable a reception than its predecessors.

JNO. A. W. DOLLAR.

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LONDON, ENGLAND,

August, 1912.

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In the above list the added letters have the following signification: (B), from Bayer's "Operationslehre"; (C), from Cadiot and Almy's "Traité de Thérapeutique Chirurgicale"; (E), from Ellenberger and Baum's "Anatomie"; and (L), from Leisering's "Atlas." Most of these figures have been redrawn.

REGIONAL VETERINARY SURGERY AND OPERATIVE TECHNIQUE.

I.—GENERAL REMARKS ON OPERATIONS.

THE word operation covers all mechanical interference undertaken for surgical purposes. Perfect restoration of function being usually demanded in veterinary surgery, many operations common in human practice must either be renounced or very seldom performed, partial recovery being worse than useless from the owner's standpoint. It is therefore often necessary to consider whether operation is justified or whether slaughter be not preferable. Owners as a class have quite erroneous impressions of the results to be expected. Many are not satisfied even when the animal's usefulness is completely restored because perhaps a trifling blemish remains. Some seem incapable of understanding that a certain time is necessary for recovery. They imagine that healing can be forced, become impatient, and in a few moments destroy by clumsy interference, or too early use of the animal, the results of weeks of skill, afterwards seeking to hold the operator answerable. In veterinary surgery the conditions for rapid healing are much less favourable than in human practice.

The unsatisfactory sanitary surroundings, the active opposition of the animal, and frequently the impossibility of shielding the wound from injurious external influences, as in human surgery, often render success imperfect even with the greatest care and attention to detail.

Division. Operations are divided according to varying circumstances. Those requiring the use of the hands alone are sometimes known as manual operations; the terms dressing and instrumental operations explain themselves. We speak also of elementary or compound, bloodless or sanguinary, regular or irregular; of urgent

operations and operations which may be deferred; of operations on the skin, the muscles, bones, tendons, and so forth; operations on the head, neck, trunk, etc., names which require no explanation. Urgent operations are such as cannot be postponed without gravely endangering life.

The indications and contra-indications for operation must be carefully studied. Beginners are not infrequently over hasty in this respect. For instance, they declare an operation indispensable; the owner refuses his consent, and nevertheless recovery results under simple treatment, or even without any treatment at all. The clinics are perhaps somewhat to blame for this, as only severe cases which must be operated on are usually brought there, and even though in each case the special grounds which render operation indispensable are set forth, the student is apt to retain only a general impression, such as of a tumour and of the subsequent operation, forgetting the explanatory remarks. Such mistakes are made at first by everyone. Except in the case of urgent operations, like tracheotomy for threatening suffocation, operation for strangulated hernia, removal of a foreign body, etc., it is first necessary carefully to consider whether the animal's value, its chance of perfect recovery, and the probable duration of its convalescence, justify operation at all. The need for operation and the dangers it implies must be clearly placed before the owner. A wise practitioner, however, will not, except in very urgent circumstances, insist on immediately operating for fear of prejudicing his client, but after a moderate expression of opinion will wait, knowing that the failure of other means will finally force the owner himself to demand operation. Definite promises should never be made in order to gain the owner's consent, for, considering the extreme variability of wound-healing, results can never be foretold with absolute certainty. When surgical treatment can only have a temporary good effect and the disease is likely to return, when improvement is only to be obtained by sacrificing the animal's usefulness, or when the patient is old, or its strength is too greatly reduced, the practitioner's duty to his client is clearly to deprecate operation even if called upon to perform it. In the last connection dogs suffering from malignant disease are often submitted for operation in an extremely emaciated state. Should they die under the operator's hands the fact is related to the surgeon's discredit without any reference to the other circumstances.

Planning the Operation. Before performing any operation the operator should mentally enact the details of each of the proposed stages. This mental process is unconsciously performed before the

simplest operation, but only when rare and difficult operations are projected does its necessity force itself on our recognition. In very difficult cases operation may previously be performed on the dead body and the anatomical relations noted.

During the process one also determines the method of operation, for one method does not suit every case and it must be left to the ability of the operator to select the method he regards as being the best suited to the case in hand, the simplest to practise and as promising the desired result in the shortest time. Circumstances arising during the operation itself often necessitate unforeseen modifications, and test to the utmost the operator's resource and ingenuity.

The instruments selected must include not only those required for the operation itself, but for all complications which may possibly arise. At the same time the simpler they are, *cæteris paribus*, the better.

Preparation of the Animal. Great importance used formerly to be attached to the preparation of the animal, which was bled, and purged *secundum artem*. Such methods are now nearly obsolete, and the chief precaution required is to avoid casting an animal with a full stomach, overloaded bowel, or distended bladder, although the fear of rupturing the stomach, bowel, or bladder has been greatly exaggerated, as is proved by the small mortality in animals cast for urgent operations without reference to the state of the bowels, etc. It is, however, certainly advantageous to restrict the patient's diet before practising reduction of hernia, cryptorchid castration, spaying, and operations on the womb.

The seat of operation should be thoroughly cleansed, the hair shaved off, and in the case of operations on the foot a local antiseptic bath should be given.

Operations become necessary at all times of the day, but when a choice is available the best time is probably the morning, as any unfavourable sequelæ, like secondary bleeding, are more easily discovered and dealt with then than in the late afternoon or evening.

Recovery is often favoured by turning the animal to grass, for which reason spring is a very good time to choose when an option exists. The extremes of temperature occurring in winter and summer are disadvantageous. Great heat favours putrefactive processes in wounds, and flies, besides irritating the animals, often infect the parts.

Place of Operation. When no special operating room is available, some open well-lighted spot, sheltered from wind and dust, should be chosen. The ground should be covered with clean straw to the

depth of eighteen inches or two feet. Litter should certainly not be used. For dogs an operating table will be found most convenient.

It is seldom wise to operate in a loose-box. If the horse is lying and unable to rise it should be drawn into an open space.

Assistants. In preparing for an operation sufficient reliable assistance must be provided. Each assistant should be carefully instructed beforehand in his duty, whether it be holding, casting, or fixing the animal. To command efficiently and preserve order the surgeon must thoroughly understand every detail himself, a knowledge which can only be acquired by actual manual performance. Students, therefore, should themselves have opportunities of casting horses, each taking command in turn, until all know their duties. In addition to the men required for holding, casting, and tying the horse, the operator requires an intelligent personal assistant. An expert is not always necessary; a layman with some dexterity serves the purpose very well. This assistant should wash, shave, disinfect, and prepare the field of operation; collect the needful instruments, hold retractors, sponge the wound, etc.; but as he then comes in contact with the wound in nearly the same degree as the operator, the same precautions are incumbent on him as on the surgeon in relation to disinfecting hands, nails, etc. For extensive, complicated, and dangerous operations, however, such an assistant is inadequate. A qualified person is then almost indispensable, inasmuch as he should know immediately what to do in the event of dangerous complications arising; what to compress, what to grasp, which instruments to hand, etc. There is often no time for the lengthened explanations a layman would probably require.

Operations like the removal of tumours, etc., are seldom very urgent; the surgeon has full time, therefore, to make all necessary preparations and to arrange for the help of a fellow-practitioner. Unfortunately, however, there appears to be an impression amongst many that the practitioner injures himself in the view of the owner of the patient when he suggests a consultation with, or the assistance of, a colleague. Others consider, on the contrary, that such a request is the best means of impressing on the owner the importance of the case, the difficulty of the operation, and the care which the practitioner is exercising; and many of the younger generation of veterinary surgeons are beginning to adopt this view and to imitate their colleagues in human surgery.

After-treatment. In many cases the after-treatment is even more important than the operation itself. The animal must be carefully watched to prevent it tearing off the dressing, rubbing

or biting itself, lying down, etc., while the temperature, condition of the wound, and its surroundings, etc., must be observed, so that any deviation from normal may be early remarked and precautions taken in time.

II.—MEANS OF CONTROL.

Operation, or even local examination, is often impossible without recourse to methods of restraint, of which an exceedingly numerous choice is available, depending on the species of animal and the operation to be performed. To begin with, the horse should be securely bridled or haltered and held by a reliable man, who will give his whole attention to the animal, and at once check any indication of vice by calling to the animal, or similar means.

Vicious horses may often be quieted by the application of blinds. Before casting, a special well-fitting winker bridle, the lower part of which can easily be removed, should be applied. The winkers should be padded and provided with straps, by which they can be brought together. By preventing it seeing, blinds often render the animal remarkably tractable, while they also protect the eyes when the animal falls, and whilst it remains on the ground. Some

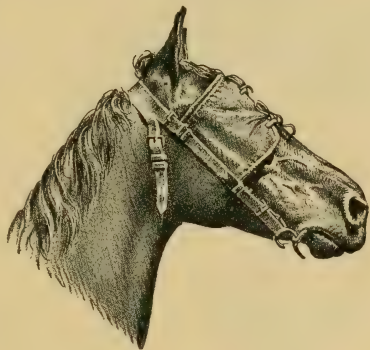


FIG. 1.—“The blinds.”

persons use a sort of leather cap or hood which is drawn over the animal's head. Some arrangement of the kind is indispensable when horses have to be cast. A substitute may be extemporised from a thick piece of cloth doubled several times, passed over the eyes, and fastened to the back of the bridle. Horses which bite may be muzzled.

To divert the animal's attention from the local pain, twitches are often applied to the upper or lower lip, or to the ear. They produce most effect on well-bred horses. The simplest and most frequently used twitch is formed of a strong cord, threaded through the upper end of a stout rod. The end of the rod furthest from the loop is provided with a cord, by which the twitch, when applied,

may be attached to the cheek-strap of the bridle. This obviates the necessity for a man holding it. The rod must never be fixed on that side of the face on which the animal will fall when cast, and

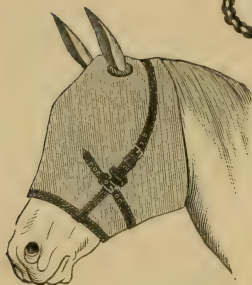


FIG. 2.
Operating cap or hood.



FIG. 3.
The twitch.



FIG. 4—"The bulldogs."

on which it may then continue to lie for some time. When dealing with very troublesome horses, the twitch stick may preferably be much longer, say six feet, and of proportionate thickness. It is then held by a man, who thus gains a considerable leverage over the horse, and is better able to control it. Neither the iron "bulldogs" (Fig. 4) nor the loop twitch (Fig. 6) is to be recommended. The loop twitch not infrequently lacerates the angles of the mouth, and it may induce partial sloughing of the cheeks. A very much better twitch is formed by passing the loop under the horse's upper lip, so that it lies above the upper incisors. This controls the animal almost as effectually, and is not likely to produce a blemish.



FIG. 5.—The leg-twitch.

The leg twitch is shown in Fig. 5. A stout piece of rope, about twenty inches long, is formed into a loop, through the open ends of which a wooden rod is thrust. This is applied to the hind limb, about four to six inches above the hock, and is tightened by twisting the rod.

It being impossible to apply the ordinary cord twitch to the ox,

a kind of forceps is used, which grasps the lower section of the nasal septum. The bull-holder (Fig. 8) is provided with loops at the free ends of the handles, by means of which it can be secured to the animal's horns. In the bull-holder shown in Fig. 9 pressure is applied by means of a screw.

Nose-rings may here be mentioned; the most convenient are those which can be inserted without the assistance of an instrument. Hauptner's pattern (Fig. 10) is very practical. It consists of two semicircular pieces connected by a hinge; one end is pointed and cutting, for the purpose of transfixing the nasal septum; this fits into a corresponding depression in the other end, and is provided



FIG. 6.—The loop twitch.

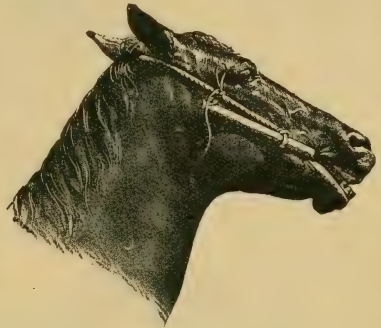


FIG. 7.—The loop-twitch tightened by inserting a wooden rod.

with a notch to receive the spring catch shown in the figure. Figs. 11 and 12 represent leaders for animals in which these rings have been inserted.

To means of restraint also belong gags—instruments for holding the jaws apart to allow of examining or operating within the cavity of the mouth or pharynx without danger of being bitten. Some are fixed, others movable, the latter allowing the mouth to be more or less opened as desired. One of the simplest forms of fixed gag consists of a heart-shaped piece of iron with two transverse branches fixed about four inches apart. It is thrust into the mouth horizontally until the upper cross-piece comes in contact with the upper molars, and then rotated so that the upper cross-piece remains in contact with the interdental space and the animal's chin lies in the lower rounded space. Movable gags are preferable. The principle is similar to that above described, but the distance apart of the two

transverse pieces may be altered by means of a screw. Brogniez's gag has a semicircular bar, which connects the horizontal branches



FIG. 8.—Bull-holder.

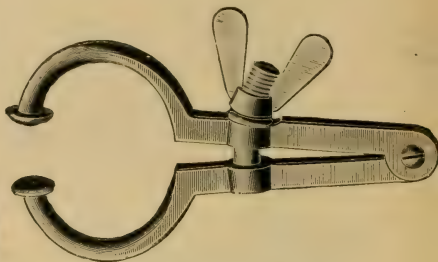


FIG. 9.—Bull-holder.

resting in the interdental space of the upper and lower jaws respectively, and which may be moved to either side. This gag has the disadvantage of requiring to be very strongly, and, therefore,

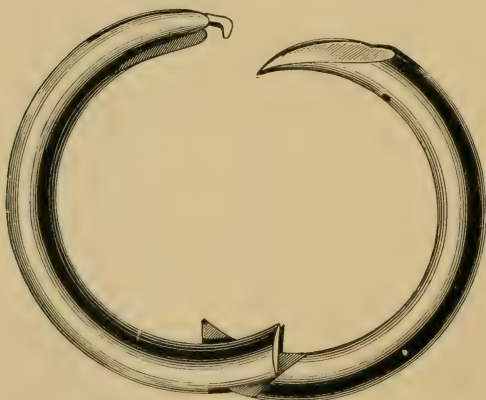


FIG. 10.—Nose-ring for bull.



FIG. 11. FIG. 12.
Bull-leaders.

heavily made, though it certainly leaves the mouth very clear for operation. Mackel's gag is lighter, and does not require to be fixed

with the hand. The upper and lower horizontal branches are separated by the rotation of movable nuts screwing on the two



FIG. 13.—Showing the application of nose-ring and bull-leader.

vertical connecting rods. Fig. 14 is Varnell's form. The transverse bars are covered with rubber. Until recently it was by far the most

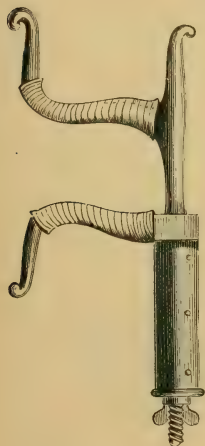


FIG. 14.—Varnell's mouth-gag.

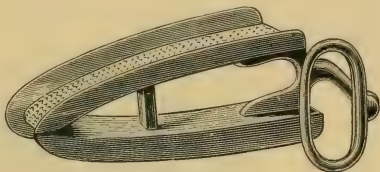


FIG. 15.—Bayer's mouth-gag for horses and oxen.

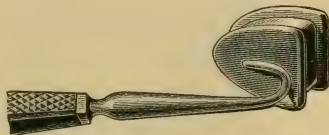


FIG. 16.—Bayer's mouth-gag for dogs.

popular form in this country. Fig. 17 is a design of Hertwig and Fuchs, so modified by Joger as to render it very portable.

During prolonged operations the gums become severely bruised, even when the transverse bars of the gag are well covered with

rubber. To avoid this, Bayer, of Vienna, made the grinding surface of the molar teeth the point of support for a gag. This gag, shown in Fig. 15, will be seen closely to resemble that used for many years in operations on the mouth in man.

It consists of an upper and lower portion, each provided with

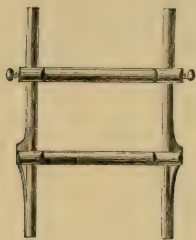


FIG. 17.—Joger's mouth-gag for horses. This apparatus can be dismantled and packed in a very small space.

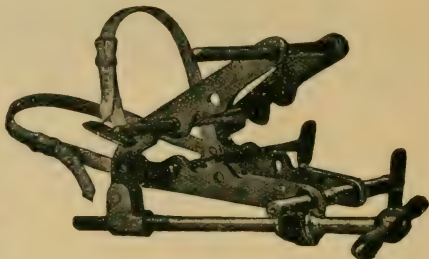


FIG. 18.—Woolf's mouth-gag—new form.

guides for retaining the instrument in position on the respective rows of molars. The two portions are inclined towards each other at an angle of about 15 degrees. The back carries a handle for inserting the gag in place. The surfaces of the two plates being



FIG. 19.—Woolf's mouth-gag—old form.

roughened, after the manner of a rasp, assist in holding the instrument firmly when pushed between the upper and lower molars. In use the animal's tongue is grasped with one hand and withdrawn, the instrument held firmly in the other hand is then introduced into

the mouth and pushed between the upper and lower rows of molars as far as it will go. The instrument should be steadied in position with one hand, whilst with the other the examination is made. As the operator himself controls the gag, he has ample warning to withdraw his hand in case of danger. Haussmann's mouth-gag for horses (Figs. 20—22) is probably the best and most convenient. Whether

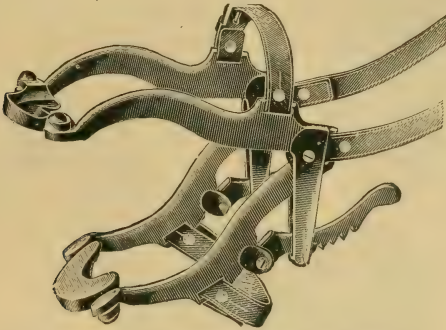


FIG. 20.—Haussmann's mouth-gag (open).

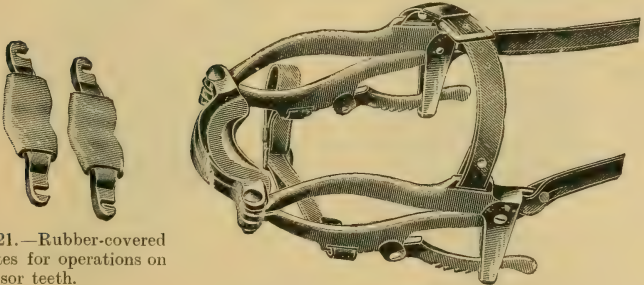


FIG. 21.—Rubber-covered plates for operations on incisor teeth.

FIG. 22.—Haussmann's mouth-gag (closed).

it was first invented by Haussmann or by an unknown American is open to question. In Germany it is known as Haussmann's; in England as the American mouth-gag. It possesses the important advantage of pressing only on the incisor teeth, and therefore is not liable to injure the mouth, however long its application; it leaves the cavity of the mouth entirely clear, a great point when operating on teeth; it is relaxed in a moment, and as readily extended. It can be dismounted and packed small and flat for

travelling, and being nickel-plated and of rounded form, the parts are easily disinfected. To permit of operations on incisor teeth

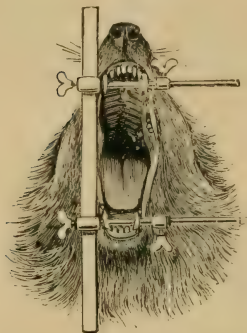


FIG. 23.—Mr. Gray's mouth-gag for dogs.

two rubber-covered plates are supplied, which fit across the interdental space and replace the ordinary teeth plates (Fig. 21). The gag shown in Fig. 16 is for small dogs. That designed by Woolf is useful both for large and small dogs. Fig. 19 shows the older, Fig. 18 the newer improved apparatus. Fig. 23 represents the very simple and effective mouth-gag for dogs and cats introduced by Mr. Gray, M.R.C.V.S. It is very simple and cheap, is readily adjustable for large or small animals, and leaves the mouth unobstructed for operation, etc.

In operating on dogs precautions are required to prevent the



FIG. 24.—Pulling up and fixing a fore-foot for operation.



FIG. 25.—Tying up the fore-leg.

patient biting. The best and easiest method consists simply in securing the mouth with tape. A loop of broad unbleached linen

tape having been slipped over the animal's nose and lower jaw, and drawn tight, the end proceeding from the right side is carried towards the left ear, that from the left side towards the right ear, and the two fastened firmly behind the head.

In some operations on horses it is sufficient if the ears are grasped by a couple of powerful assistants and the head drawn forcibly downwards. This does not completely insure the operator's safety, but it checks attempts at rearing and striking with the front feet. This method of drawing down the head is certainly better than



FIG. 26.—Fastening the fore and hind pasterns together as a means of restraint.

fastening the animal to a fixed object, though in cattle the best available means often is to fix a rope around the horns and attach it to a strong ring or post.

Another means of restraint is to lift a fore or hind foot, preferably on the side on which the operator stands; care must be taken, however, not to raise the limb so high as to give pain and cause the animal to rear. A fore-foot may also be raised and kept in position by passing a cord around the pastern and over the withers, in which position it is held by an assistant. This plan is preferable to that next shown, viz., of fixing the pastern to the forearm by means of a rope or strap. In this case a small bundle of straw is often thrust into the

flexure of the knee to prevent the cord slipping off. As, however, the horse is apt to lose its balance, a serious fall sometimes results.



FIG. 27.—Pulling up and fixing a hind-foot for operation.

To prevent striking out with the fore-feet a foot may be lifted or both legs fastened together above the knees. Another plan is to pass a cord or strap several times around the forearms and fasten it to the surcingle. Some operators fasten the fore-limb to the hind-limb of the same side by a cord passed round the pasterns (Fig. 26). This prevents the horse striking out, but may cause a severe fall should it struggle. There are several methods of holding up a hind-foot. A loop of cord may be passed round the neck and one of the free ends carried along the back as far as the root of the tail, around which a turn is taken; the rope is then passed once around the pastern of the hind-foot to be

held up. The horse is thus forced to bear a great part of any strain he may put on the limb. This is a simpler but not a better method

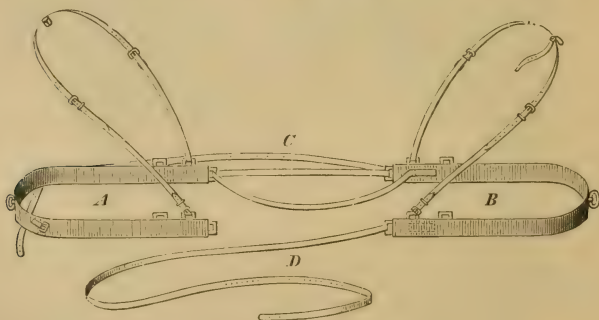


FIG. 28.—The Hippo-lasso.

than that of Hann, who carries a cord from a ring fixed to the top of the surcingle, first over the back and croup, then through a

crupper and through the ring of a hobble attached to the pastern, returning once more through the crupper. By drawing on the free

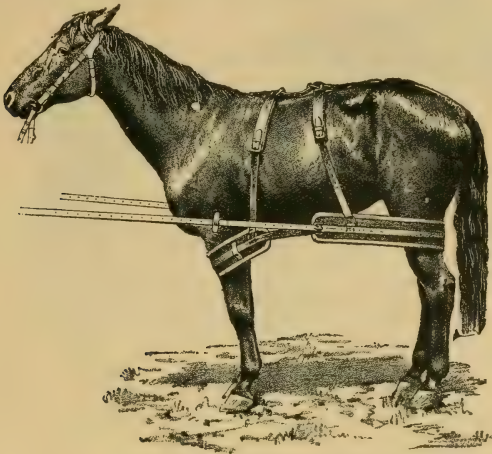


FIG. 29.—The Hippo-lasso applied.

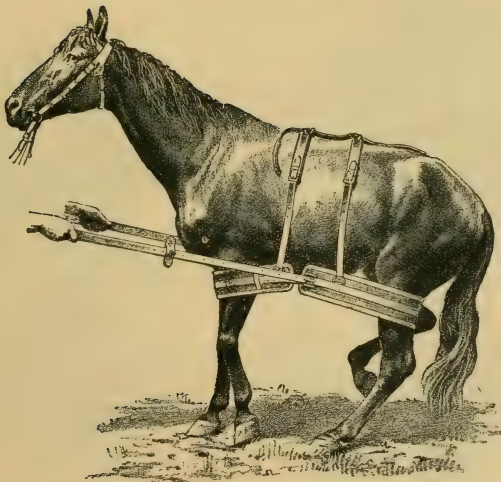


FIG. 30.—The Hippo-lasso in operation. The horse is about to lie down.

end of the cord the foot is raised and can easily be held in position. In other cases the tail itself may be utilised, the cord being first fixed

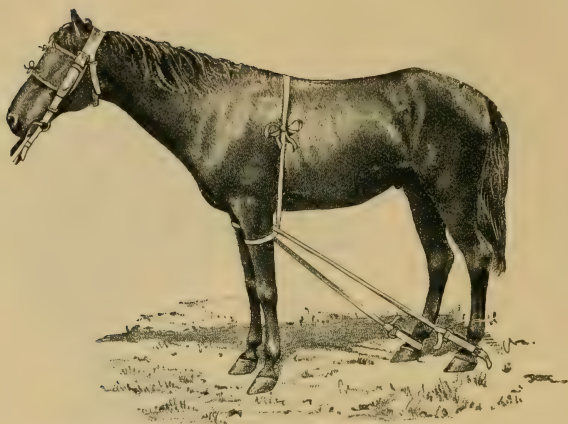


FIG. 31.—Method of securing the hind legs to prevent kicking during operation.



FIG. 32.—Fastening a bullock's hind legs preparatory to operation.

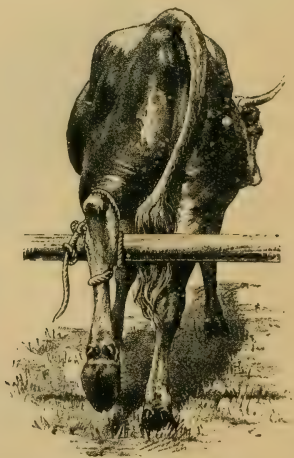


FIG. 33.—Fastening one hind leg for operation or shoeing.

to it by a "double sheet bend" (*i.e.*, a special kind of knot which will not slip), and then passed through the ring of a hobble, when by drawing on the rope the foot will be raised. For dangerous horses

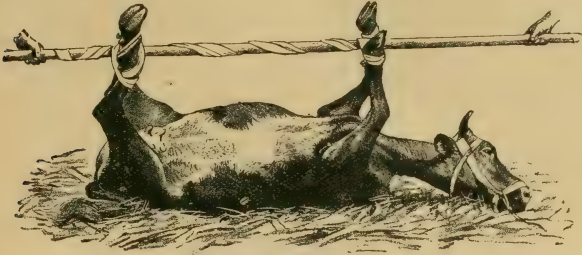


FIG. 34.—Fastening a cow for operation.

a very useful apparatus is the hippo-lasso. It may either prepare the way for using hobbles, or may even supersede them. It consists

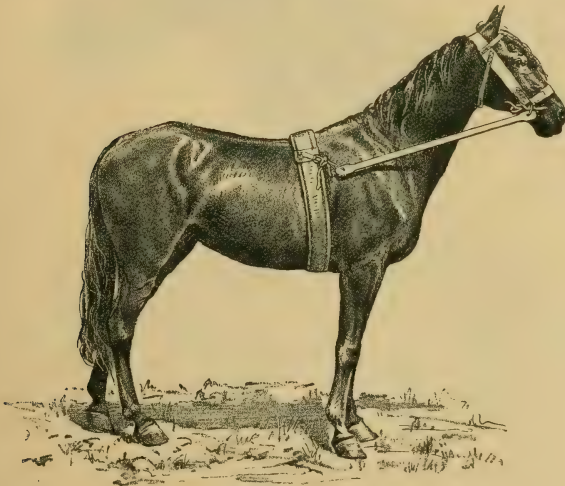


FIG. 35.—The side-stick.

of a front and hind portion hung by broad straps which pass across the back just behind the forearm and in front of the stifle-joint respectively, and held together by two other straps fastened to the

front and running through rings in the back portion. By pulling on these straps the animal's fore and hind limbs are drawn together, and it is effectually prevented from kicking either with the fore or hind limbs. Many horses when thus secured lie down without struggling. To secure the hind limbs hobbles are applied to the pasterns, from each of which a broad band of webbing is carried towards the centre of the chest from within outwards around the forearm under the preceding portion and vertically upwards over the withers. The two pieces of webbing may then be tied together.

Hess describes many very useful ways of fixing oxen, of which the best are shown in the accompanying illustrations (Figs. 32, 33, and 34).

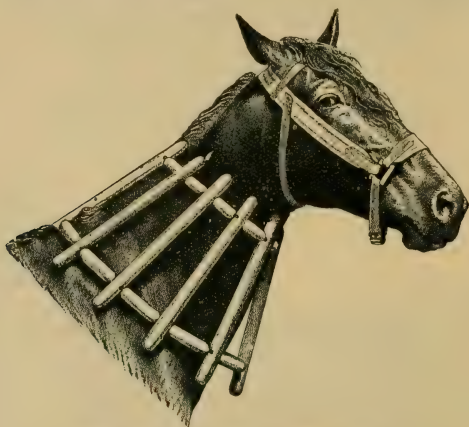


FIG. 36.—The "cradle" or "beads."

Among other means of restraint must be numbered the side-stick (Fig. 35), a cylindrical well-rounded stick of elm or other tough wood fixed at one end to the head-collar and at the other to the surcingle, thus limiting the movement of the head and neck. A somewhat similar result is obtained by the use of the "cradle" (Fig. 36).

"The stocks," or "trevis," is so well known as scarcely to require description here. It was used in classic Greece. It renders good service in certain operations, but is too clumsy, too little adaptable, and too large for many purposes. Farriers still use it for shoeing, and country practitioners for operations on oxen and on heavy horses.

All vaccine institutes, and most foreign veterinary schools and

veterinary hospitals now contain some form of table for controlling horses during operation.

The first apparatus of this kind of any practical value was Daviau's. It consisted of a large oak table about 8 × 6 feet, the upper part of the front padded with horse-hair and covered with

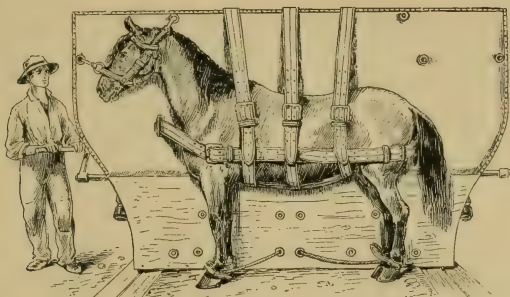


FIG. 37.—Daviau's operating table. Horse secured.

stout leather, the lower portion and the ends perforated with holes for the passage of ropes, the whole pivoted on a horizontal axis, to which was attached a rackwork quadrant. At the back was a stout framework about 2 feet 6 inches in height, with four legs so arranged that the upright table could fold back upon it, when the whole had

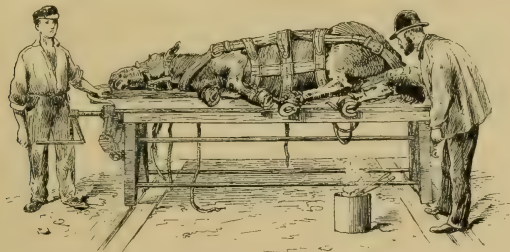


FIG. 38.—Daviau's table. Horse in position for operation.

somewhat the appearance of an extremely massive and rather low kitchen table. In practice the horse, already provided with a powerful head-collar, was led up to the apparatus, and strong ropes attached to the head-collar were passed through holes in the table and secured at the back to belaying-pins. At the same time the

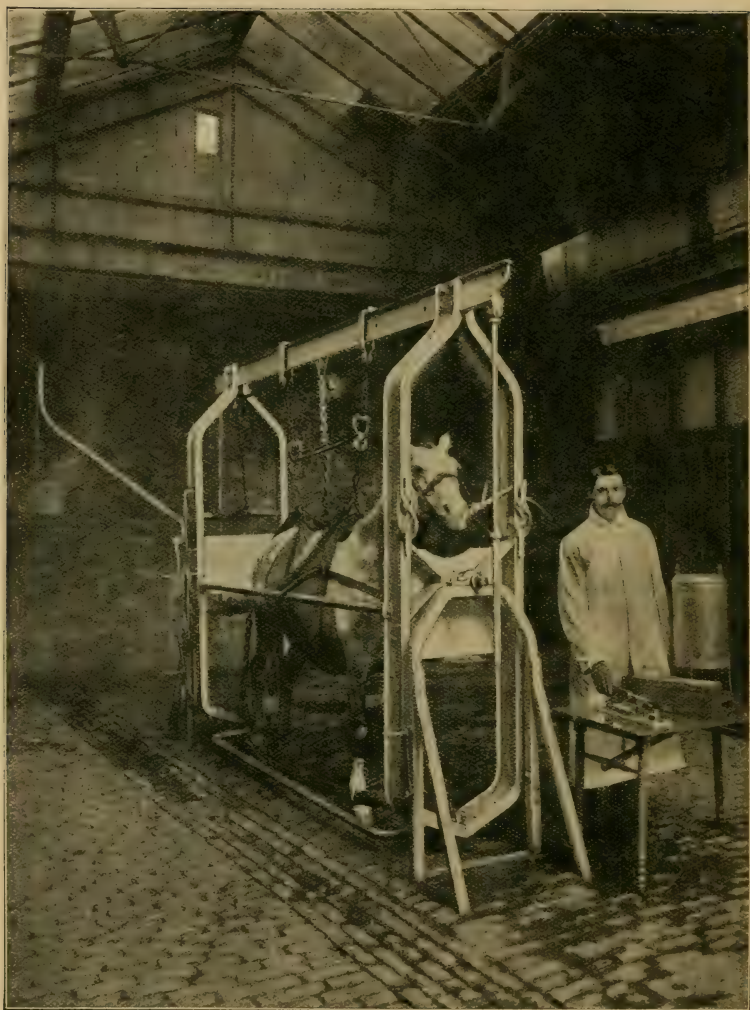


FIG. 39. —Operating table used by Mr. Dollar. The horse secured for operation.

broad horizontal strap (attached at each end to the table) was brought round the chest and flank, and fastened by drawing the buckles tight. The vertical straps were secured, the hobbles adjusted on the feet, and the ropes controlling them tightened and fastened to belaying-pins behind the table. Thus secured, the horse and table were turned through the arc of a circle by working the crank handle seen on the left side.

For minor operations this table served a very useful purpose, but a patent defect was the inaccessibility of one side of the horse, and the need, when both sides had to be operated on, of releasing, turning round, and refastening the animal.

The most practical apparatus hitherto introduced is probably that shown in Figs. 39 and 40. It was originally invented about 1890 by M. Vinsot, a former student of Alfort, but at that time was not centrally pivoted and possessed few advantages over Daviau's table. Since then, however, Monsieur Vinsot has greatly improved it and the apparatus is now in use in all the chief foreign veterinary schools and hospitals.

The main portion of the apparatus is seen roughly to consist of two approximately rectangular end pieces, connected at the top by a strong steel girder, and at the bottom by a strong iron rod of circular section. These rectangular frames are further connected at 2 feet 6 inches from the ground by two movable rods, adapted to swing open, and the whole framework is supported and pivoted on two powerful axes, placed as nearly as possible on a level with the general centre of gravity of the whole machine. A double cushion, intended to support the horse when lying, is capable of attachment to either of these side rods.

The purpose of the various ratchet wheels and chains will be better understood by reference to the figure showing the horse secured in position for operation. His head, secured by a strong head-collar and side-ropes, rests within the padded upper portions of the front frame. Under his body passes a strong "bed-piece" reinforced with leather straps, the extremities of which carry iron eyes for the reception of a chain, by tightening which he is lifted almost off his feet just before turning over. In front this "bed-piece" is secured in position by a strap passing round the chest, and behind by a crupper attached to the back chain. The chain is wound on a spindle, turned, through the medium of gearing, by the crank handle shown. The horse's feet are fixed by hobbles to a strong chain running along the whole length of the bottom of the apparatus, and tightened by turning the lower of the two crank handles seen to the left.

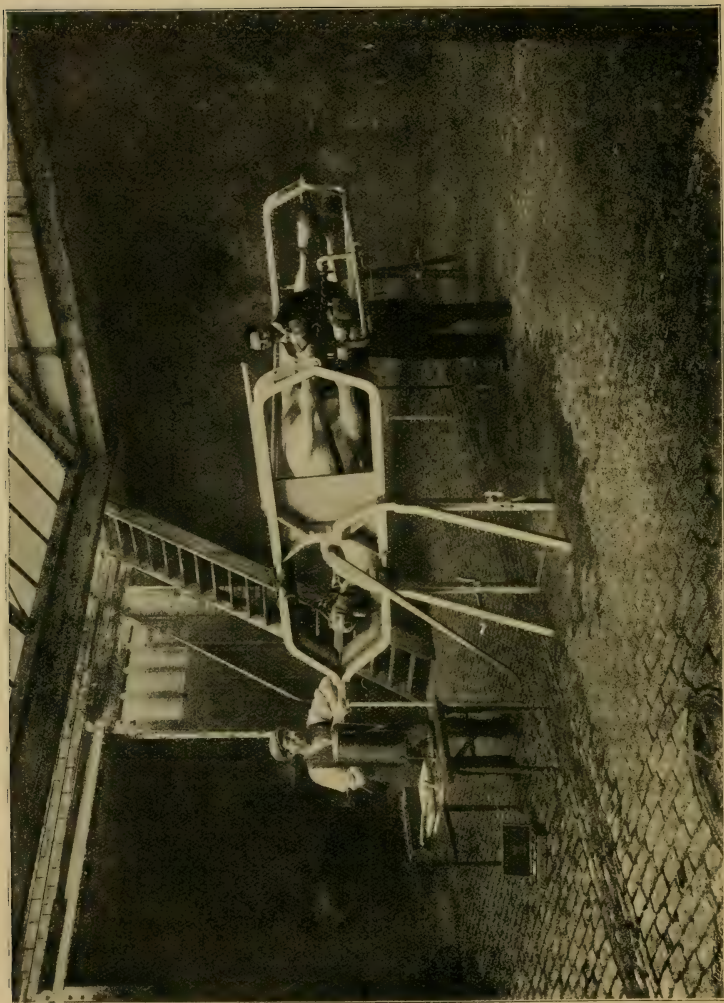


FIG. 40.—In position for operating; patient turned to the left. Showing the free accessibility to all parts.

To support the revolving part, which weighs 7 cwt. and is capable of accommodating horses of any size, two strong iron standards 4 feet 6 inches high, and provided with stays of 2-inch iron, are sunk in the ground, where they are surrounded by masses of concrete weighing five tons. This provides a practically immovable base, on which any accidental shocks can have no effect. Each standard carries at its upper part a carefully turned bearing to receive the axes of the revolving part.

The forward end-piece is padded inside to prevent the horse accidentally injuring his head, and is perforated throughout its upper part with one-inch holes to permit the head-collar ropes being passed through and fastened to spring belaying-pins seen projecting in front.

The rods suspended from either end of the upper girder are telescopic, and automatically stop the machine when tilted at whatever point desired by the operator.

Lastly, the revolving portion of the apparatus in which the animal is fixed is secured against premature movement by four "safety chocks" or catches secured to the standard, and locking with the end frames. The lever arm shown at the back and on the left side of Fig. 39 can be affixed to either end of the machine, and gives the operator the necessary purchase for moving the animal when in position.

The disposition of weight has been so carefully planned that when ready for rotation horse and machine form a mass whose common centre of gravity is within an inch or two of the horizontal axis around which the whole moves. Very little exertion is therefore required in handling even a heavy horse, and no undue strain is thrown on the machine, whatever the point at which it may be brought to rest.

In use, the horse is first provided with a strong head collar carrying two stout lines, and the "bed-piece" is strapped tightly round his body like a horse-rug. One of the side rods is swung open, giving admission to the machine, and the horse is walked forward until his head comes within the front frame. At the same moment the assistant follows up with the side bar, and as the horse enters, drops the bar in place, where it locks of itself. The groom passes the head collar lines through holes in the front frame, and drawing them tight winds them in a figure of 8 round the spring belaying-pins, while the "bed-piece" is hooked on to the hanging "compensation bar." If a comparatively simple operation is to be performed nothing further is needed. A hind-foot may be drawn up and fixed for examination or dressing, and the horse be set at liberty again in less than a couple of minutes.

If, however, any serious operation is required four hobbles are affixed to the feet, the winch handles are turned (both together) until the horse's feet begin to leave the ground, when the safety chocks are cast off, permitting the apparatus to revolve, and depositing the horse without shock or pain in a horizontal position. The animal may be placed at any degree of inclination to the horizontal, and its position on the table is extremely safe. Broken back has never occurred within the writer's experience.

Methods of Casting. A permanent bed is usually prepared with six to eight inches of dry spent tan bark covered with a thick layer of short cut straw. Many practitioners still prefer the straw bed to mattresses, because it is softer and because it can be removed, and fresh straw supplied after each operation, whilst the mattress must be thoroughly cleansed and disinfected. It has also the advantage of being cheap, as clean straw is readily obtainable and may afterwards be used for bedding, whilst it is a difficult matter for veterinary surgeons in country practice to convey a mattress from place to place. Nevertheless, straw makes a very bad bed for aseptic operations, and wherever possible it should be replaced by a mattress covered with tarpaulin, or by a proper operating table, though some of the disadvantages of the straw bed may be overcome by covering it with a large tarpaulin before casting the horse. Even so high an authority, however, as Bayer adhered to the straw bed, preferring it partly because he had to teach students who, in practice, would be unable to afford an operating table, and partly because of the success attained in his own clinique. In support of his recommendation he adduced a long series of cases in which the wounds left by the removal of shoulder abscesses, necrotic lateral cartilages, etc., healed by primary intention after suturing.

To prevent internal injuries, like rupture of abdominal viscera, the animal should fast or only receive light food for several hours before operation, though, as already mentioned, this precaution is not absolutely indispensable. Should it be impracticable to perform the operation in the standing posture the operator should throw the horse on a sloping bed or bank of straw, so that the animal may fall as easily as possible. One of the simplest methods of casting is that shown in Fig. 41. It is especially useful for young animals or those difficult to approach, in which ordinary hobbles cannot be used. It is also useful where the hind legs have to be drawn downwards on either side of the body for operations in the dorsal position, inasmuch as the application and removal of hobbles are thereby rendered unnecessary. In case of need a cart rope may be

used. A strong bridle or halter and a surcingle carrying a ring and rope having been applied, a man is placed at the horse's head, and another, who holds the surcingle rope, is given a position on the side towards which the animal is required to fall. If possible the fore-foot furthest from the bed is then lifted. On the end of the long rope is tied a fixed noose, which is placed round the animal's neck like a collar; the free end is then passed around both hind legs, brought forward, again passed through the loop on the animal's shoulders, and given to the men charged with casting the animal. On the word being given, these men should rapidly draw the rope backwards towards the side to which the horse is intended to fall.



FIG. 41.—Casting with the cart rope. Attention is directed to the fact that both hind pasterns are embraced in the one loop of rope.

The rope thus catches in the heels just below the fetlock and the animal is thrown on its haunches. At the same moment the man holding the cord attached to the surcingle pulls in a similar direction. The attendant in charge of the head assists the movement, and the horse falls to the ground. This method causes the least concussion, and can even be safely used for pregnant mares. The only objection is that if the ropes be new, or the first attempt fail, the animal's heels may be injured, but this can be avoided by previously applying bandages or using cotton ropes. Where many horses are cast by this method the loop of rope passed round the neck may advantageously be replaced by a strong leather strap provided with iron

eyelets, through which the rope is returned, these eyelets diminishing friction and permitting the rope to run more freely.

A commoner method of procedure is to form in the centre of a long rope a fixed loop sufficiently large to pass round the animal's neck and rest on its shoulders. The knot lies in front of the chest, and the free ends of the rope are passed from within outwards round

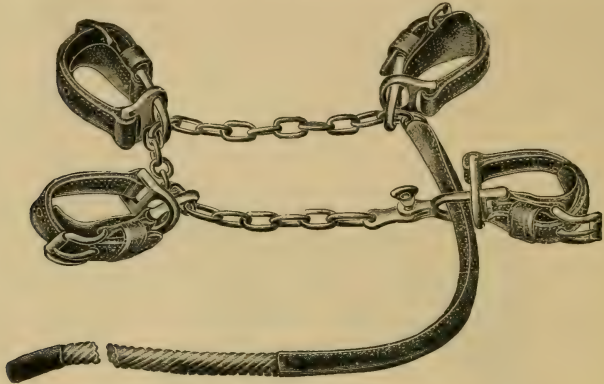


FIG. 42.—The hobbles.

the hind legs above the hocks, and back again through the neck loop. They are then held on each side by one or two men, according to the animal's size and weight. When all is ready one of the forefeet is lifted, the loops of rope are slipped from above the hocks downwards into the hollows of the heels, and the men pull steadily on the free ends of the rope, causing the animal to subside on its

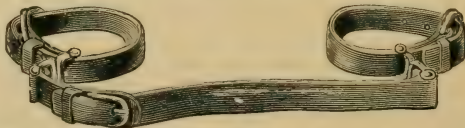


FIG. 43.—Cross-hobbles, or thigh and forearm straps.

hocks, whence it usually falls gently on to its quarters. It is best if one group of men pulls outwards at right angles to the shoulder and the other somewhat backwards. Immediately the animal is on the ground it is pushed on to its back, the ropes are pulled tight, drawing down the hind legs level with the abdomen, and secured to the pastern with one or two half-hitches. The fore legs are firmly

grasped, brought alongside the hind, and secured to them by a couple of half-hitches passed round the pasterns. This method has the advantage of requiring no re-arrangement of the ropes to draw down the hind legs and so expose the field of operation for castration, though, as the hind limbs are at first comparatively free, the animal can plant them wide apart, and the force required for casting it is somewhat greater than in the method previously mentioned. It is usually employed when castrating colts. Some operators use a stout leather strap collar with iron eyes for the passage of the ropes, instead of merely passing them through the improvised rope loop. When the

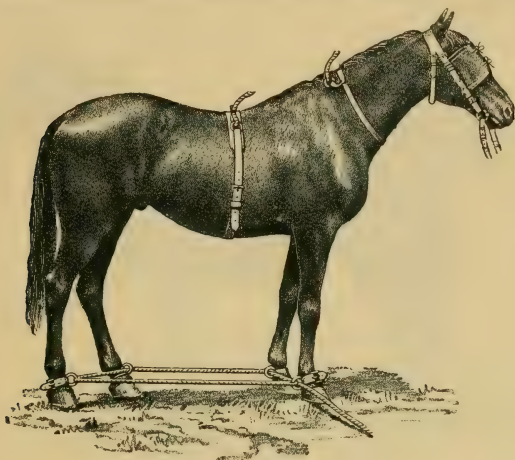


FIG. 44.—The hobbles applied.

animal is very active, it is well to affix a roller or surcingle to which the collar or neck loop can be tied ; otherwise the latter may slip off.

To work the above methods successfully requires thorough discipline of and co-operation between the various assistants. Inattention on the part of anyone may entail serious accident or failure of the whole operation. The method of casting, however, most frequently employed is that illustrated in Figs. 44 and 45, which show the application of leather hobbles. The hobble usually applied to the upper fore-limb is called the master-hobble, and carries a special key, by means of which the chain or rope is attached. Traction on the rope draws the feet together, the horse begins to lose its balance, and at the critical moment the rope attached to the surcingle is pulled, one or more assistants helping if necessary by pulling on

the tail. The hobble rope should be pulled in a backward direction, as this to some extent neutralises the strain on the assistants, and prevents the animal's legs being pulled directly from under it and so bringing it violently to the ground. The assistants should be well drilled beforehand, and the operation carried out as quietly as possible. In Fig. 45 the horse is provided with Bernadot and Butel's apparatus for preventing broken back. The difference between this and the Stuttgart method may be seen on reference to Fig. 46.

The advantage of the Stuttgart arrangement is that the ropes

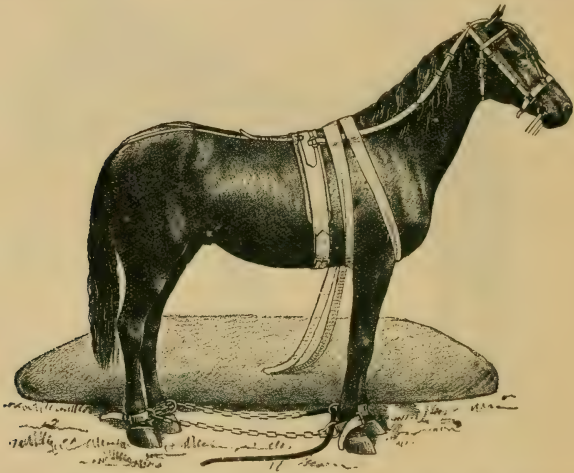


FIG. 45.—The hobbles applied together with Bernadot and Butel's apparatus for the prevention of broken back. The strip of webbing passed round the off forearm is intended to afford a purchase when pulling the horse over in the act of casting.

run more easily, as each only passes through one link; and as the direction of pull is opposite for the two groups of men, there is no tendency to bring the horse down violently on its side.

The horse having been brought to the ground is kept down by the man at the bridle firmly pressing on the head, and other persons sitting on the shoulder and haunch respectively. The four feet having been tightly drawn together are fixed by passing a key (Fig. 47) through a link of the chain. The spring key shown is perhaps less convenient than the D-shaped spring key, though there is no essential difference between the two. As a makeshift the chain

may be fixed by forming a slip-knot as close as possible to the hobbles and passing a bundle of straw through the loop. The person at the horse's head must take care that the animal does not succeed in bending its head towards its chest and arching its neck, because this attitude, which facilitates contraction of the great muscles of the back and quarters, is often responsible for fractures of the vertebræ.

To retain the head extended Bernadot and Butel invented an apparatus consisting of a strong head-collar, from which powerful straps run backwards above the neck, and are attached on either side to a ring in the surcingle. The surcingle is prevented from slipping forward by the use of a crupper. The apparatus is applied

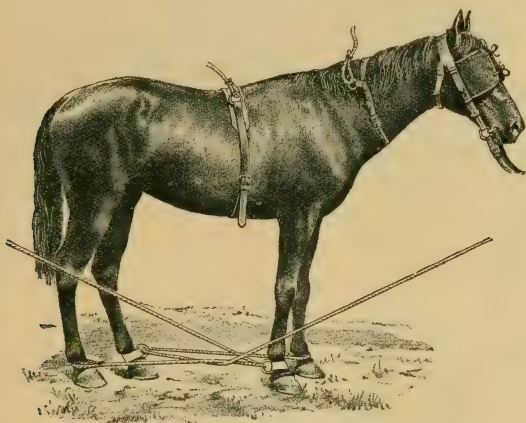


FIG. 46.—Method of casting as adopted at the Stuttgart Veterinary School.

loosely before casting, and the straps tightened after the animal is on the ground.

The releasing of an animal depends on the method employed for casting. Most hobbles are arranged so that all four feet are immediately loosened by withdrawing the screw-key of the master hobble, but where no such arrangement exists the fore and hind feet of the lower side should first be set free, and then those of the upper side. The assistants sitting on the shoulder and haunch should not move until the man in charge of the bridle is quite prepared for the animal's rising, and the word of command has been given. Should the fore-quarters be on a lower level than the hind, or the back lower than the feet, the horse may have difficulty in rising. In such case the fore-feet must be drawn out in front of

the horse, and the animal assisted by men placed at its quarter, shoulder, and tail.

The animal having been cast, it may become necessary to release and again secure a limb, according to the operation to be performed. For this purpose the best material is webbing; cords are apt to cut. The webbing having been doubled, a running loop is formed in it and slipped over the horse's fetlock; the two ends of webbing are then passed in opposite directions and held fast by assistants. The men sitting on the shoulder and haunch can also check the animal's movements by utilising their weight and by grasping the limbs with their hands. A better method, however, is to pass a loop of webbing around the two forearms or cannon bones. Movement in the fore and hind limbs which are for the moment uppermost, can also be



FIG. 47.—The hobble-chain key.

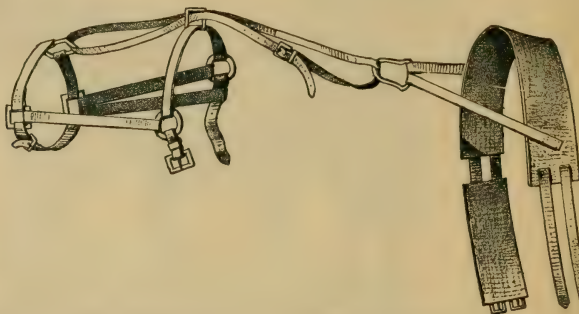


FIG. 48.—Bernadot and Butel's apparatus for the prevention of broken back.

checked by passing a large strap or piece of webbing over the hock-joint and then around the forearm, or by the application of the cross-hobbles shown in Fig. 43.

For operations on the fore-limb, like extirpation of the lateral cartilage, neurectomy, etc., Möller's method of fixing the limb to a long plank is very useful. The plank should be well padded, and provided with a long curved iron handle. It is less useful for hind limbs, inasmuch as the limb can only be fixed at two points, viz. at the fetlock and above or below the hock.

To draw a hind-foot closer to a fore-foot, as in preparing for castration in the side position, a running loop is formed at the end of a piece of webbing and slipped over the fetlock of the hind-foot; the webbing is then carried over the withers, beneath the neck, over the front of the chest, around the forearm, and thence backwards, passing from below upwards around the Achilles tendon and once

again forwards. By pulling on the free end an assistant can then bring the limb into the position shown in Figs. 51, 52. Another



FIG. 49.—Horse cast and secured. The near forearm and near thigh are fastened together by broad strips of webbing (the cross-hobbles may be used instead), and the off fore-leg is fastened to the plank ready for operation on the foot. (Möller's method.)

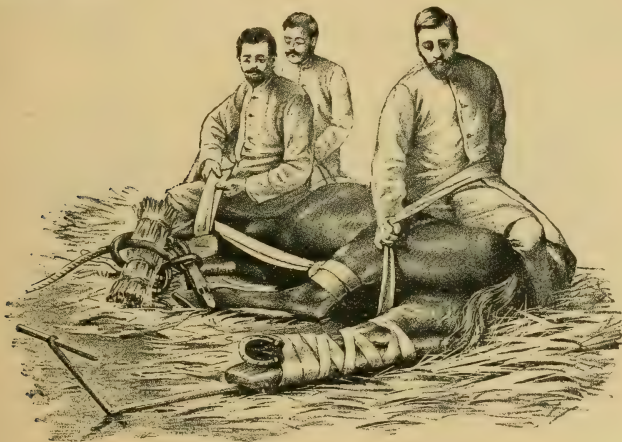


FIG. 50.—This figure shows method of securing a hind limb to the plank for operation. Compare with foregoing figure.

way of attaining the same object (the Berlin method) is shown in Fig. 53.

The method of fixing the upper hind to the upper fore-limb is shown in Fig. 54; that of fixing the lower hind to the upper fore in Fig. 55.

For operations in the dorsal position the fore and hind limbs of each side must first be firmly fixed together. Either rope or webbing



FIG. 51.—The horse cast and tied. The off hind leg being drawn forward ready for castration in the side position.

can be used, the fastening being accomplished by means of a running noose attached to the fetlock of the hind-foot, and by applying one or two half-hitches to that of the fore-foot, drawing the rope tightly after each half hitch is in position. When the horse is rolled on to its back, care must be taken that the neck and head are kept straight

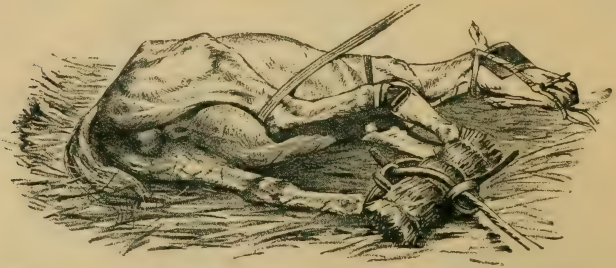


FIG. 52.—The horse secured ready for castration in the side position.

and the head is not allowed to be bent towards the chest. A piece of webbing can then be fastened to one of the hind limbs just above the fetlock, passed under the animal's back, and then from within outwards over the fetlock of the opposite side. By drawing this tight the hind legs are pressed down close to the sides and secured. In Vienna a special piece of apparatus is used for this purpose. The



FIG. 53.—Another method of preparing the horse for castration or similar operation in the side position.



FIG. 54.—Fastening a hind to a fore-limb preparatory to neurectomy, firing, etc.

method is as follows :—One or two assistants grasp the horse's tail and lift the hind quarters far enough from the ground to allow a leather band, about eight to ten inches wide, to be slipped under. The ends of the band carry broad iron rings. Through these and around the cannon bones of the hind limbs broad pieces of webbing are passed, securing the hind limbs in place. The cannon bones must be pressed downwards into a horizontal position, whilst the parts are being fixed (Fig. 57). (NOTE.—In this figure the assistants on the left side of the animal are not represented, and the horse is purposely shown lying a little obliquely, in order that the mode of fixation may be clearer.) The operation finished, the broad leather



FIG. 55.—Fastening the lower hind to the upper fore-limb preparatory to neurectomy, firing, etc. This figure also shows the "leg twitch" applied.

strap passed beneath the animal is first removed : the horse is then laid on his side, the limbs are released, the upper being last of all freed from hobbles. Fig. 58 shows another method of fixing a horse for operation as employed in the Berlin veterinary school.

The Russian method of casting (Figs. 59–61) permits of a man throwing a horse single-handed. In books the position of the operator's hands is usually incorrect. With small horses the method succeeds very well, though requiring some courage. The operator stands close to that side of the horse on which it is intended to fall, and at the first trial this seems dangerous. Bayer, in referring to the operation, states that on one occasion he actually fell under the

horse. He had attempted to cast a rather large horse, and had nearly succeeded ; the animal, however, tried to regain its equilibrium by a slight spring, and trod on Bayer's foot, preventing his getting clear.

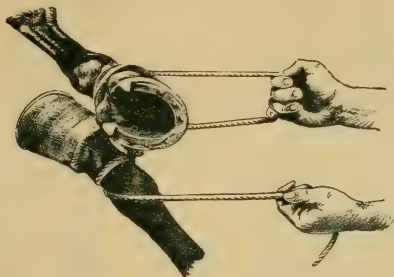


FIG. 56.—The horse cast. Mode of fixing the fore and hind limbs together when preparing for castration in the dorsal position.

A long rope carrying a ring at one end is used. Supposing a horse is intended to fall on its left side, a loop is formed in the rope and passed around the neck, the ring lying near the right elbow. The free end of the rope is then passed around the left hind-foot,



FIG. 57.—Preparing for castration in the dorsal position. The back strap applied. (Vienna method).

again through the ring, and is held in the operator's right hand. The operator stands on the horse's left side looking forwards, his right elbow supported on the horse's loins, and the bridle reins grasped in the left hand. By lifting the left hind-foot under the

belly and somewhat towards the right side, drawing the head to the right by means of the bit, and simultaneously pressing with the elbow on the loins. the horse is caused first to recoil on its haunches, and then to lie down on its left side. The operator has only to hold the cord and bridle tight to prevent the animal rising.

Cattle can be cast like horses with ordinary hobbles, the straps being placed above the fetlocks, or by the method shown in Figs. 62 and 63. A rope having been fastened to the horns, is passed around the neck, chest, and abdomen as shown. The animal is held by an ox-lead, and two men pull on the end of the rope, when



FIG. 58.—Berlin method of fixing the horse in dorsal position for operation.

the animal usually lies down on its side without struggling and with its feet stretched out.

For castration the sheep is placed on its hind quarters in a sitting position, the abdomen being turned towards the operator. An assistant grasps the body between his legs and holds a limb with each hand. For carriage the fore and hind legs of each side are first tied together, the two sides being afterwards connected by a few turns of the rope.

The pig is best seized just above the hock, and can then be cast by an assistant who grasps the ears. In the large stockyards, however, men become very expert in casting the pig single-handed, by slipping a short staff between the hind legs as the animal runs. To examine

the mouth, a short stick is thrust between the jaws at the moment when the animal squeals, and can then be used as a lever to keep them open. A kind of twitch applied to the jaws is also used.



FIG. 59.—The Russian method of casting, single-handed; first position.



FIG. 60.—The Russian method of casting, single-handed; second position.



FIG. 61.—The Russian method of casting; the horse down.

Another method is as follows :—Two men grasp the pig by the ears ; when the animal cries, a slip-knot, formed on the end of a stout cord, is passed into the mouth and fastened to the upper jaw as near as

possible to the commissure, behind the tusks. The cord is then fastened to any high point or to a ring, and the head drawn into a position of forced extension. The animal cannot possibly escape.

The dog is either muzzled or the jaws fastened together by a piece of tape passed around them and tied behind the ears. It is then

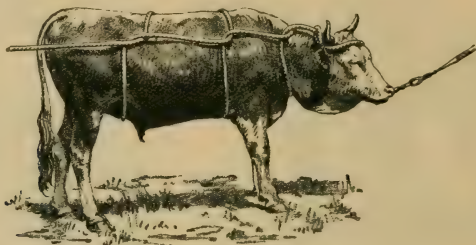


FIG. 62.—Casting an ox ; first position.

easily handled and secured on the operating table. Several operating tables have been invented for dogs. In Vienna the table is a shallow glass trough about 3 feet 6 inches long and 15 inches across, with an aperture for drainage, and suitable connections at the lowest point. This is surrounded by a detachable metal frame, the lower surface of which carries a series of hooks at one-inch intervals for fastening the cords by which the animal is secured. In the very excellent clinique for small animals at Berlin, the table is of similar

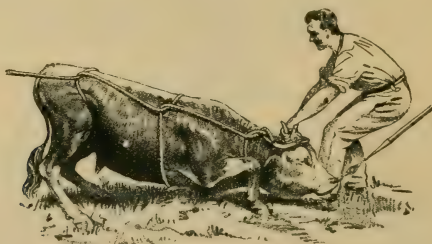


FIG. 63.—Casting an ox : second position.

form, but is constructed throughout of metal. Both tables, in fact, are close imitations of those used in human surgery.

In this country, Hobday has suggested a cheap and useful table of wood, the upper surface perfectly flat and displaying numerous slots for receiving the small keys by which the hobbles are secured

to the table. This table, now made of metal, can be readily cleansed and rendered aseptic. Another excellent table, of wood, designed by Claude Bernard, consists of four parallel leaves connected by hinges. The two outer leaves may be inclined at any angle towards one another, forming a trough to receive the animal's body. Owing to its great simplicity and absence of depressions likely to retain dirt, etc., this table is cheap, and responds to most of the requirements of veterinary surgery, while it is readily adaptable to animals of varying size, and when folded is quite portable.

A special instrument is used in France for securing dogs suspected

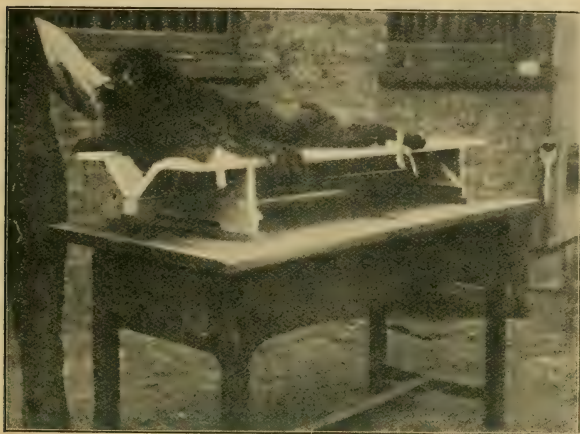


FIG. 64.—Operating table for the dog. (Claude Bernard's design.)

of rabies. It has a long handle, and carries at the end a spring collar which, when pressed on the dog's neck, opens and holds him securely.

For castration and other operations on the cat, the skin at the back of the neck is grasped with one hand, that over the lumbar region with the other, and the subject firmly pressed down on a table. Another method is for the assistant to grasp the hind limbs on either side between the second and third fingers, the fore-limbs between the index and second fingers, and the skin on either side of the head with the index finger and thumb. Thus held the animal is quite powerless. Troublesome patients may be wrapped in a thick cloth to prevent scratching and biting. It is sometimes recommended to thrust the animal into a narrow sack or into a boot.

These methods, of course, are primitive and only suitable for trifling operations. For more complicated operations one or another of the above-mentioned tables may be used.

Other methods of casting and restraining horses, cattle, pigs, and dogs, will be found fully described and illustrated in *Restraint of Domestic Animals*, by Dr. White, Nashville, Tenn., U.S.A.

Complications. Application of the above-described methods of restraint are not infrequently followed by injuries or complications. The animal begins to resist immediately the hobbles are applied. A horse often struggles, kicks, or moves away on finding the free use of its limbs checked, and may fall awkwardly, breaking the jaw, neck, shoulder, or a limb bone, according to the incidence of the shock. Fracture of the spine, pelvis, or ribs is not infrequent when horses are cast suddenly and violently. Even when secured, the muscular efforts consequent on struggling may cause fractures of vertebræ, of the pelvis, of the femur, os calcis, etc., rupture of abdominal viscera, of large vessels, important muscles, or of tendons, not to mention the skin wounds and contusions which frequently occur. Pressure on nerves such as the facial or radial, due to lying long in one position, may be followed by cramp or paralysis.



FIG. 64A.—All-metal operating table for small animals.

III.—ANÆSTHESIA.

ANÆSTHESIA may be divided according to its nature and extent into general and local. We shall consider these in order.

The first operation under ether was performed on the 14th October, 1846, by Warren, in the Faculty of Medicine at Boston. Boots and Lister first employed ether in England. During 1847 several veterinary surgeons published experiments showing the advantages of its use in operations on the horse.

Notwithstanding certain drawbacks ether was at first exclusively used, but on the 10th November, 1847, Simpson drew attention to the anæsthetic qualities of chloroform, which he declared superior to its predecessor. Chloroform soon displaced ether, maintaining its supremacy in man until a relatively recent date. In animals, save perhaps the dog and cat, it is still the most popular anæsthetic.

Other substances have since been introduced. The first departure was probably the mixture of ether and chloroform, with or without alcohol. The rectal administration of ether was then suggested, followed by the use of morphine, the intra-venous, intra-rectal, or intra-peritoneal injection of chloral, the inhalation of chloroform in conjunction with subcutaneous injections of morphine and atropine, and the administration of paraldehyde, urethane, and methylene. When, as in oxen, the flesh would be used for human food in case of the operation failing, large doses of alcohol are often given.

In general anæsthesia the patient is thrown into a more or less profound artificial sleep. It is not always necessary, however, to act on the entire individual. Sometimes the operation only affects a very limited area, and local anæsthesia suffices. Local anæsthesia may be produced by the application of ice or freezing mixtures, by the spraying of certain liquids, like ether or ethyl chloride, or by the subcutaneous injection of a solution of cocaine, eucaine, stovaine, or novocaine.

Anæsthetics are quite as useful in animals as in man; and few important operations are performed on veterinary patients without anæsthesia, either local or general. For most minor operations, the means of control at our disposal are sufficient without general anæsthetics, but certain operations cannot be well performed without them. In reduction of herniæ, delivery in cases of dystokia, in laparotomy, and all cases where one works in dangerous proximity to important organs, the animal's struggles render general anæsthesia almost indispensable. It is also necessary for delicate operations on or

in the vicinity of the eye, and for all serious operations on horses, whose struggles are particularly violent. Möller recommends anæsthesia in castrating horses with very powerful dorsal muscles. In ruminants anæsthesia is seldom resorted to save in difficult parturition. In carnivora, and especially in the dog, its principal indications are in laparotomy, difficult parturition, amputations, and certain operations on the head.

Anæsthesia is contra-indicated (1) in diseases of the heart (lesions of the valves or myocardium, dilatation, and hypertrophy); (2) diseases of the respiratory tract (emphysema, pneumonia, and chronic pleurisy).

Ether is the best anæsthetic for subjects with emphysema and dilatation of the right heart, chloroform for those with affections of the left heart, chloral when the pulse is intermittent (Arloing).

Death may be caused by pushing administration too rapidly; in certain rare cases it may also result from accidents like vomiting, the vomited material passing into the trachea and lungs, and producing mechanical pneumonia. Such a termination is much to be feared in man unless the patient be properly prepared, but it very seldom occurs in the horse. If in operations on the face, such as trepanation of the facial sinuses or nasal cavities, or extraction of molar teeth, an anæsthetic be employed, the head should be placed in a depending position, so as to favour escape of blood, which might otherwise enter the respiratory tract and produce suffocation.

GENERAL ANÆSTHESIA.

Narcosis being the result of a special action exerted directly on nerve-centres by the anæsthetic agent, the first necessity is to insure a sufficient quantity of the anæsthetic arriving at those centres. While fixed anæsthetics can be administered by various channels, such as the veins, mucous and serous surfaces, the subcutaneous tissue, etc., volatile anæsthetics must penetrate by the respiratory mucous membrane. Injected into the tissues or veins, fixed anæsthetics traverse the pulmonary capillaries without sensible change, and act promptly on the nerve-centres; volatile anæsthetics, similarly administered, escape in large measure through the walls of the pulmonary vessels, are expired, and fail to reach their destination in sufficient quantity to produce much effect. On the other hand, volatile substances, introduced in a state of vapour into the respiratory tract, are freely absorbed by the blood circulating

in the lungs, which blood, passing thence to the left heart and general arterial system, rapidly produces anæsthesia.

Anæsthetics administered by the respiratory tract produce a series of phenomena in the following order :—(1) period of excitation ; (2) period of anæsthesia or surgical period ; (3) period of collapse or intoxication.

The **period of excitation**, due firstly to the action of anæsthetic vapours on the nerve terminations in the mucous membrane of the upper respiratory tract and paralysis of the cerebral inhibitory centres, and afterwards to the action of these vapours on the great nerve-centres themselves, is characterised by perverted sensation, excitement, and hyperæsthesia of sense organs. Violent struggling occurs, respiration and circulation become accelerated, the mucous membranes injected, and the pupil dilated ; the heart's action, however, soon slows, respiration becomes easier, more regular, and more extensive, the pupil contracts, excitement diminishes, and sleep commences. During this period anæsthetics may, in animals predisposed to such complications, produce respiratory or cardiac syncope or asphyxia from spasm of the glottis.

The **period of anæsthesia** is characterised by suspension of activity in the nerve-centres, *i.e.* the cerebral lobes, medulla oblongata, and mesocephalon. The animal is plunged into artificial sleep. The excito-motor centres are paralysed, the muscles relaxed, the limbs when raised fall inertly. Respiration is slow, the movements of the chest wall are diminished, but those of the flank more marked than ordinary. The heart is accelerated, on account of paralysis of the moderator centre, but the pulse remains regular and full up to the moment when intoxication occurs. Vision is no longer co-ordinated, while the pupils remain contracted and immobile. As sensation is lost in the various regions reflexes cease.

Sensation does not disappear simultaneously in all tissues and all regions, being last retained by organs under spinal control. The limbs and trunk are first affected, then the organs of sense and those supplied by branches of bulbar origin, finally those supplied by the sympathetic system. The nasal, buccal, auricular, and genital mucous membranes exhibit reflexes long after other parts have become insensitive. Even when anæsthesia appears complete, struggling often results immediately the knife touches the diseased region. This is due to certain diseased tissues retaining a morbid sensibility even after neighbouring healthy tissues have entirely lost sensation. Inflamed parts especially retain their sensibility long after healthy tissues. Once established, anæsthesia can be maintained by very

small doses of the agent employed ; larger amounts are dangerous, as being liable to induce the third stage of anæsthesia, viz. **collapse or intoxication**. This is characterised by progressive retardation of respiration and circulation, and by sudden dilatation of the pupil. Respiratory movements become superficial and cease for comparatively long periods ; the heart's action diminishes, the pulse is small, soft, and irregular. Finally the medulla becomes intoxicated, respiration is arrested, the heart ceases to beat, and death occurs by respiratory syncope.

The phenomena of anæsthesia vary according to whether ether, chloroform, or another anæsthetic is employed. With ether the period of excitement is longer and more pronounced than with chloroform. With certain fixed anæsthetics the phase of excitement is suppressed or little marked. Although the exact action of chloral is still open to discussion, it is known to produce immediate and profound anæsthesia without preliminary disturbance when administered intra-venously. On the other hand, salts of morphine sometimes produce lively excitement prolonged for some hours. The difference, however, interests physiologists more than practitioners. The chief point for the latter is the degree of toxicity of these agents, *i.e.* the danger attending their use. No general anæsthetic is without danger, and even in veterinary surgery, where the employment of anæsthesia is limited, every practitioner has probably had a fatal case.

ANÆSTHESIA IN THE HORSE.

Chloroform probably produces the most rapid and complete anæsthesia in the horse. It is not so dangerous for solipeds as has been suggested. The writer, whose experience extends to nearly a thousand cases, has only seen two fatal results, which occurred after deep surgical anæsthesia had been maintained, in one case for over two hours, and in the other over three. Needless to say, recovery of consciousness is slow after prolonged operations, and the animals may not rise for half an hour to an hour after their termination, but given reasonable care in administration chloroform fulfils all requirements.

In company with Dr. Clarke, the writer attempted on several occasions to kill animals by the administration of air saturated at ordinary temperature with chloroform vapour, but the experiments all proved the extreme difficulty of the attempt. Where, however, the animal is partially asphyxiated, as in using several of the common veterinary inhalers, death can be produced in eight to ten

minutes. By using a special apparatus, by means of which absolutely pure chloroform vapour, *without admixture of air*, was administered, death was produced in one and a half minutes. The heart's action continued for several minutes after respiratory arrest. Möller, who employs chloroform exclusively, has administered it to many hundreds of horses without a single accident.

As a basis for investigation, Möller noted in each of his cases the time required to produce surgical anæsthesia, the amount of chloroform used, the breed, age, sex, and weight of the animal. The following is a *resume* of the more important results. In a series of 126 cases (31 stallions, 38 mares, and 57 geldings) anæsthetised with chloroform, the corneal reflex was abolished in an average period of 20 minutes by the administration of an average quantity of 28 fluid drachms of chloroform; the quantity per unit of body-weight was 1 : 4000; anæsthesia usually lasted about 20 minutes.

Whilst in one to two years old animals 4 to 5 drachms of chloroform usually produced anæsthesia in 7 to 8 minutes, the shortest time observed in full-grown horses was in one case 8 minutes, in one case 9 minutes, and in two cases 10 minutes. Twelve of the above 126 horses required 30 minutes, and four from 30 to 40 minutes. In stallions the average period was 18, in mares 19, and in geldings 22 minutes. The stallions on an average consumed 30 drachms of chloroform; 7 horses (3 stallions, 2 mares, and 2 geldings) took, however, less than $12\frac{1}{2}$ drachms; on the other hand 18 (5 stallions, 4 mares, and 9 geldings) required 38 fluid drachms, or over. One gelding received 60 fluid drachms, and an English thoroughbred $62\frac{1}{2}$ fluid drachms. The average age of the stallions was 5, of the mares 9, and of the geldings 7 years.

It is worth noting that the quantity of chloroform used depends partly on the method of administration. Apart from the quantity lost by leakage or evaporation, less is required when administration is slow than when it is rapid. The quantity used, therefore, often stands in inverse proportion to the pre-anæsthetic period.

Breed seems to have little relation to the anæsthetic influence of chloroform; it neither affects the quantity required nor the pre-anæsthetic interval to any appreciable extent. On the other hand, it was noted that geldings on an average required considerably more chloroform than stallions and mares.

Twenty-eight horses received subcutaneous injections of $7\frac{1}{2}$ grains morphine before administration of chloroform. In these cases the average quantity of chloroform used was 24 fluid drachms, and the time interval before complete anæsthesia $15\frac{1}{2}$ minutes.

Eight horses were given a mixture of equal parts chloroform and ether. The average quantity used was 54 fluid drachms, and the time interval 30 minutes.

Needless to say the sample of chloroform used must be pure, and should contain no free chlorine, which produces excessive irritation. To prevent chloroform undergoing change by keeping, a little ether is added to it and the liquid placed in yellow bottles with ground stoppers and stored in a cool dark place. Another method consists in adding 1 part in 1000 of sulphur which has previously been washed with ammonia, and afterwards with water.

Apparatus. Chloroform can be administered from a towel, sponge, tampon of tow, or a linen compress, but in England Cox's or Carlisle's muzzle is usually employed. Although the rapid method is considered dangerous by some, it is that most commonly used.

Abroad great precautions are taken. The chloroform is given from a compress, and by one nostril only, being added drop by drop at the rate of two or three drops per second. To avoid irritation, produced by the liquid coming in contact with the skin or mucous membrane, the nose may be smeared with vaseline.

Being very volatile, chloroform can be given by a modification of Junker's apparatus. In its simplest form this consists of a tall glass cylinder, containing the anæsthetic, closed by a bung or large rubber cork pierced with two holes, giving passage to wide glass tubes. One tube passes to the bottom of the glass; to this is affixed the bellows; the other, which only just passes through the cork, is provided with a rubber tube which can be slipped into the animal's nostril. By working the bellows, air is forced through the liquid, becomes charged with the anæsthetic, and, passing into the nostrils, is inhaled. A large form of this apparatus, made in copper and worked by a foot bellows, was very successfully used by Dr. Clarke (who invented it) and myself during 1887-9 in operations for roaring. The glass bottle was replaced by a copper cylinder about fifteen inches in height and four in diameter, the glass tubes by large metal tubes about three quarters of an inch diameter. The long tube passed to the bottom of the copper cylinder and through a circular plate of perforated metal. The blast of air was thus broken up into innumerable small bubbles, which became thoroughly saturated with the anæsthetic vapour. As after prolonged use the apparatus grows extremely cold, and is apt to become clogged from the freezing of water vapour derived from the blast of air, it was found advantageous to place it in a bucket containing warm water. Later forms

of Dr. Clarke's apparatus are surrounded with an outer metal receiver for containing hot water.

A simple form of inhaler was suggested by the late J. Roalfe Cox, F.R.C.V.S. It consisted of a leather tube covered with stout canvas, which could be drawn together at either end by a strong drawstring. The tube was slipped over the animal's nostrils and into its mouth, the drawstring tightened and attached to the halter. A sponge saturated with the anæsthetic was then introduced, and the supply of air controlled by regulating the size of the external opening. The Carlisle inhaler is more complicated, but probably not more efficient. It envelops both the upper and lower jaws, thus differing from Cox's, and is provided with a metal sliding sponge-holder on which the chloroform is poured. As sent out it gravely impedes respiration, and for use the writer has modified it by removing the lower solid end, so that the only obstacle between the animal's nostrils and the outer air is the comparatively pervious layer of sponge for receiving the chloroform. Thus altered it uses rather more of the anæsthetic, but is infinitely safer.

Surgical Anæsthesia by Chloroform. Chloroform is usually administered as follows:—Food having, if possible, been withheld for six hours, the horse is cast, and girths or other impediments to free respiration loosened or removed. During inhalation, attention must be given to the breathing and the pulse. Both are at first accelerated, but later become regular. Unless when using one of the *anæsthesia cum asphyxia* muzzles, the excitation stage is seldom attended with danger, only lasts a minute or two, and is succeeded by the period of depression.

The first stage of anæsthesia (excitation) is often accompanied by a peculiar rotary movement of the eye (nystagmus); in some animals the eyelids close, opening again when anæsthesia is complete. If, soon after the period of excitement has passed, respiration or circulation becomes impeded, or if respiration be laboured, very rapid, or interrupted, if the pulse be small, frequent, irregular, or intermittent, administration must be stopped. General muscular twitching may also occur, and calls for similar precaution. Rattling in the throat, a serious symptom in man, is of less importance in horses. In the event of its occurring, the tongue should be grasped and drawn forward. Even then the noise does not always cease, being probably due to vibration of the relaxed soft palate, which is set in motion by the stream of air passing through the mouth during respiration.

The loss of sensibility, muscular weakness, character of the pulse

and respiration, variation in the pupil, and the persistence or loss of the corneal reflex indicate the degree of anæsthesia.

Complete anæsthesia is characterised by disappearance of the oculo-palpebral reflex and contraction of the pupil. At this stage should the conjunctiva or cornea be touched no movement of the eyelids follows, and touching the cornea has therefore become the usual test of anæsthesia. When the corneal reflex ceases inhalation may be stopped, to be resumed with its reappearance. The test is doubly valuable: it shows anæsthesia to be complete, whilst its disappearance is usually long antecedent to the period of intoxication.



FIG. 65.—Cox's chloroform muzzle.

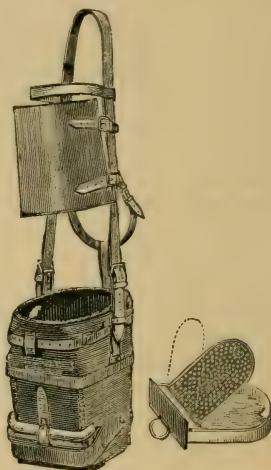


FIG. 66.—Arnold's modified Carlisle chloroform muzzle.

tion. Too much weight, however, cannot be attached to the advice "**watch the breathing.**" The breathing, and *not* the pulse or any other sign, is the only safe guide in administering an anæsthetic. The abolition of the corneal reflex usually occurs long before respiration is endangered, so that it is a *convenient* guide; but its occurrence is subject to irregularity, and it must never be relied on to the exclusion of the breathing.

Variations in the pupil also afford valuable information. As anæsthesia becomes pronounced, the pupil, dilated during the period of excitement, contracts. During anæsthesia it remains contracted and immobile, dilating slowly as sensibility returns. Rapid dila-

tation at an advanced stage of anæsthesia is a sign of bulbar intoxication and of imminent syncope.

When the corneal reflex is lost and the pupil contracted, sensibility has disappeared, and muscular relaxation is complete. Provided respiration and circulation continue regular, anæsthesia can then be prolonged for periods of two or even three hours without danger by occasionally administering further small doses of chloroform.

On completion of the operation the hobbles are removed; but the horse is left undisturbed until it rises of itself, which will usually happen in a quarter to half an hour. Should the animal be forced to rise before consciousness has entirely returned, it walks unsteadily, "bores" forward like an animal with brain disease, and may fall. To support it an assistant may walk on each side, with a hand on the point of the hip, and one behind holding the tail.

Administered with the foregoing precautions chloroform becomes a perfectly safe anæsthetic for the horse, and though individual animals show special susceptibility to its action, yet in general the danger is infinitely less than was formerly imagined.

Fatal issues result either from asphyxia or syncope.

Asphyxia usually occurs during the period of excitation, especially if some closed muzzle like the Carlisle muzzle or its modifications be used; first breathing stops, and after a short interval the heart's action fails.

Asphyxia may also happen towards the end of the anæsthetic period if administration has been pushed far and is suddenly checked. In such case the sides of the chest, face, or lips should be smartly struck with the hand or a wet towel to provoke reflexes and restore respiration. When arrest continues for an appreciable period (the writer has timed arrests of thirty to forty-five seconds), artificial respiration may be resorted to. A fairly heavy assistant stands between the animal's legs and presses with his entire weight on the animal's chest, rising again almost immediately. This is repeated at intervals of about four or five seconds. The shock should not be violent: but the man's whole weight should be employed, and special attention must be given to regularity in the process. In the horse it rarely happens that the tongue recedes and by covering the opening of the larynx causes asphyxia. Should any indication of this—like loud snoring, etc.—occur, the tongue should immediately be grasped and drawn forward.

In cases of respiratory failure some French investigators have recommended the system practised in man for resuscitation

from drowning, viz., repeated rhythmical traction on the tongue (lingual traction) at intervals of two to four seconds. The theory is that the superior laryngeal nerve and respiratory centre are thus stimulated, and in man remarkable effects have been produced, more than one person having recovered after apparent respiratory arrest extending over an hour. A small apparatus worked by electricity has been made to carry out the process.

Impending **Cardiac Syncope** is indicated by irregularity of the pulse, widely dilated pupil, weak heart's action, cessation of hæmorrhage, or the escape of a few drops of dark-coloured blood from the seat of incision. The head should immediately be lowered as far as possible, artificial respiration commenced, cold water dashed on the head, the chest wall smartly slapped, and if time permit, subcutaneous injections of sulphate of strychnine or ether should be given. Cardiac syncope may also be combated by intermittent pressure on the heart region, at the rate of 120 to 140 times per minute, or by the intravenous injection of warm normal salt solution. Hobday recommends small doses of prussic acid. Rosenberger believes that in man heart failure is due to stimulation of the vagus, owing to irritation of the respiratory mucous membrane by the chloroform vapour; he recommends previously painting the membrane with cocaine solution. The precaution is unnecessary in horses. In proof of the irritation produced, however, one may often note in well-bred horses certain symptoms of sore throat, such as coughing, etc., during the few days next succeeding the operation. Recovery usually occurs without treatment.

Administration in the standing position. As anæsthesia by chloroform is generally preceded by a short excitation period, during which the animals neigh, become uneasy, and often struggle violently, casting by hobbles or ropes, or the employment of an operating table is almost unavoidable. This, of course, is a drawback, especially when an operating table is not available, and if general anæsthesia could always be carried out in the standing position it would prove a great convenience. In the country, where a field or paddock is convenient, horses may be anæsthetised in the standing position by the use, preferably, of Cox's muzzle. The animal is held by a strong head collar, or halter with a long shank, a sponge charged with one to one and a half ounces of chloroform is placed in the inhaler, and the horse is led slowly in a circle until he sinks to the ground, when his legs can be secured with hobbles or ropes. Violent struggling is exceptional and there is little danger of spinal injury.

Partial anæsthesia in the standing posture is sometimes resorted to in shoeing vicious horses. To succeed, the horse's head must be firmly secured to a ring in the forge wall, as greater danger is to be feared from the animal becoming loose than from throwing itself down during the period of excitement. The writer has found that many animals will stand quietly until the corneal reflex becomes quite languid or almost abolished. This is the best condition for shoeing troublesome horses.

Morphine and Chloroform. When morphine is previously administered the animals sometimes show considerably more excitement than when chloroform alone is employed; and as, generally speaking, the preliminary use of morphine neither lessens the pre-anæsthetic period nor decreases the amount of chloroform required, it is rather a drawback than a help. Chloroform and ether mixtures present no advantages over chloroform alone, except in cases of heart affection.

Atropine, Morphine and Chloroform. To facilitate the throwing of restive horses and to save chloroform, Almy and Desoubry recommend a subcutaneous injection containing morphine hydrochloride ($1\frac{2}{3}$ grain), neutral sulphate of atropine ($\frac{1}{12}$ grain), and distilled water ($2\frac{1}{2}$ drachms). After an interval of half an hour the horse is cast and chloroformed.

Ether was the first and, in man, remains the favourite anæsthetic. It is administered in progressive doses from a sponge, tampon of tow, or linen compress, or by means of Cox's or Carlisle's inhaler. An ordinary deep leather bucket muzzle is a very good substitute, provided care is taken to prevent the liquid coming in contact with the mucous membrane of the nostril. If necessary, inhalation is occasionally stopped, and when surgical anæsthesia is complete the dose is considerably reduced. During the whole time respiration and the reflexes must be closely observed.

The horse having been cast, anything which might impede respiration, or compress the larynx, the lower portion of the neck, or the thorax, is removed. If Cox's muzzle be employed the procedure is precisely similar to that in giving chloroform; otherwise a linen pad about eight to ten inches square is placed over the nostrils, and ether dropped on it in small quantities. The distance from the nostrils regulates the rapidity of administration and the amount given.

The mucous membrane of the upper respiratory passages being irritable, considerable excitement is at first produced; the animal neighs, struggles, and is sometimes very violent; respiration and

circulation are accelerated. This stage sometimes lasts for ten minutes, and is succeeded by that of surgical anæsthesia.

The quantity of ether used is often considerable, from ten to twenty fluid ounces, sometimes even more. Recovery is slower than after chloroform.

Though less dangerous than chloroform, ether is not, as some suggest, absolutely innocent, and has claimed a number of victims in human surgery. Nevertheless Gurlt's statistics show the mortality from chloroform to be fifteen times greater than that from ether.

Anæsthesia can be produced by the introduction of ether vapour into the rectum. It was tried first on animals by Dupuy and Thiernesse, and has been recommended by Cagny for the purpose of producing a certain degree of drowsiness in horses to facilitate casting or to permit of trifling operations in the standing position. The method is simple; a flask or tube with a narrow neck is partially filled with ether; one end of a rubber tube is slipped over the neck, and the other end introduced into the rectum. The flask is placed in water heated to 120° F. Ether vapour is at once given off, enters the rectum, and is absorbed by the mucous membrane. One and a half to two ounces of ether are sufficient. Experience does not show this method to have any marked advantages. In place of partial anæsthesia active excitation often follows. Such violent expulsive efforts are sometimes made as to produce rectal prolapse. In man cyanosis, collapse, and even a kind of asphyxia have resulted. The uncertainty and serious inconvenience of this method have prevented its being commonly adopted. Mixed anæsthesia, produced by the injection into the rectum of ether vapour, and preceded by the subcutaneous administration of morphine and chloral, is slow in its effects and of little practical utility.

In English human surgery a favourite method is to obtain anæsthesia with nitrous oxide and maintain it with ether. The method has many advantages, and has come largely into use.

Chloral is usually injected intra-venously, alone or after hypodermic injection of morphine. Intra-venous injection of 20 per cent. solutions produces very rapid and complete anæsthesia. Though declared dangerous by human surgeons, this method has been recommended in France and Denmark for the horse, on account of the ease with which injections can be made into the jugular. The injection, which may be of any strength between 10 and 20 per cent., must be freshly prepared, and the best vehicle is physiological saline solution.

Intra-venous injection requires very special precautions. The

point of operation must be thoroughly disinfected, and all instruments should be sterilised. Everything being ready, an assistant compresses the vein low down in the jugular furrow; the operator then draws the skin in the direction of the head with one hand, while with the other he thrusts a needle or fine trocar into the distended vessel, taking a very oblique course from above downwards, *i.e.*, almost parallel with the vessel. Humbert recommends operating in two stages, first dividing the skin, then, after having raised the vein, introducing the needle or trocar. When the operation is done standing he chooses by preference the right jugular. The discharge of a jet of blood through the cannula when the trocar is withdrawn shows that the vein has been penetrated. An assistant holds the cannula firmly, and inclined towards the general line of the neck. The operator next introduces into the opening of the cannula a special metal plug connected to a rubber tube, which slips over the nozzle of the injecting syringe, and opening the tap injects the necessary quantity of chloral solution; needless to say, great care must be taken not to inject air. The operation concluded, he frees the cannula from the rubber tube, allows a little blood to escape, and quickly removes the cannula, supporting the skin meanwhile with the fingers of the left hand. Colin gives the dose as two and a half to three and a half drachms; Arloing three to six drachms; and Nocard one and a quarter drachms per hundred pounds of body-weight. Anæsthesia appears almost immediately. It is more or less profound, and continues for a greater or less time according to the amount of chloral injected. In a few seconds the animal is asleep, the muscles are completely relaxed, the mucous membranes slightly cyanotic, and the respiration and circulation, though disturbed for a moment, rapidly recover their normal rhythm. The animal recovers slowly, remaining stupefied for a time, and sometimes suffering from general trembling of the body muscles. At the end of half an hour to two hours the horse rises, resting for a time on its haunches. Movement of the hind limbs is irregular and uncertain. This weakness sometimes persists for one or two hours.

When the dose has been too large, or the subject is specially susceptible to the action of chloral, the sleep is very deep, the mucous membranes become darker and darker in colour, the pupil dilates, respiration and circulation become slower and slower, the temperature falls, and death may result.

If the operation be not performed antiseptically, if the opposite coat of the vein be injured when introducing the cannula, or if the

solution obtain entrance to the perivenous tissue, grave results almost always follow. The majority of those who have tried this method have had at least some cases of phlebitis, and, in consequence, have abandoned it. Phlebitis usually appears between the second and fourth days; a swelling, sometimes circumscribed, sometimes diffused, occurs in the jugular furrow. Suppuration follows; frequently a portion of tissue becomes necrotic. In one case mentioned by Cadiot the vein was destroyed throughout almost the entire length of the neck. Furthermore, chloral acts as a vasodilator, increasing hæmorrhage during operation. Finally, although it has been little used, chloral is responsible for a considerable number of deaths. Möller killed a number of horses by injecting twelve and a half drachms in solution. As the horses were not weighed, it might be said that this dose was too large, but Cadiot has had a death with the prescribed dose, where the quantity administered did not exceed one and a half drachms per hundred pounds of body-weight. Fifteen to twenty minutes after administration, when the operation was almost complete, respiration ceased, and a few seconds later death resulted, despite efforts made to establish artificial respiration.

Intra-peritoneal injections of chloral are made through the flank. A ten per cent. solution in physiological saline is used. The operation is without danger, and is simpler and more convenient than intravenous injection. Anæsthesia is produced in ten to fifteen minutes and lasts a long time. Recovery can be hastened by a subcutaneous injection of pilocarpine.

Administered by the mouth in doses of ten to twenty drachms diluted solutions of chloral produce drowsiness, loss of co-ordination of movement, but not complete anæsthesia. The method, however, is of value in practice.

Chloral and Morphine. To avoid the accidents resulting from intra-venous injection of chloral Cadeac and Malet associated chloral with morphine. They claim to produce complete anæsthesia by subcutaneously injecting a solution of fifteen grains of hydrochloride of morphine, and at the end of ten minutes giving an enema containing twenty to twenty-five drachms of chloral.

Anæsthesia is not always produced. It appears slowly, and sometimes only after prolonged excitement. Esser recommends this method where chloroform is contra-indicated.

Morphine, in the form of subcutaneous injection, has been recommended to quiet small animals, and in the horse to produce slight anæsthesia for trifling operations in the standing position. According

to the animal's size the dose varies from three to seven grains. In certain horses morphine produces somnolence and more or less pronounced relaxation of muscular tissue. Irritable or even dangerous animals become quiet and easy to handle. Others, however, even after large doses, show excitement lasting several hours. The patients act violently, exhibit disordered movements, kick and thrust their heads against the wall as in indigestion complicated with brain mischief. Morphine must, therefore, be considered uncertain as an anæsthetic; nevertheless, it renders some service, and in small doses is devoid of danger. Opium, or Indian hemp is, however, usually preferable.

ANÆSTHESIA IN RUMINANTS AND SWINE.

Except in cases of difficult parturition general anæsthesia is seldom resorted to in ruminants or in the pig. Tabourin and Saunier, who made a long series of experiments with **chloroform** and **ether**, came to the following conclusions:—1. That in oxen, ether produced anæsthesia without difficulty. 2. That the animals succumbed to its action more readily each time anæsthesia was repeated. 3. That chloroform was so much more energetic than ether as to warrant its entirely displacing the latter, despite its higher price. Given by the mouth 12 to 18 fluid drachms of chloroform only produced incomplete anæsthesia.

Fröhner failed to obtain any anæsthetic action from doses of 10 drachms of **chloral**; given by the mouth, 6 to 10 drachms produced unsteadiness of the hind quarters in fifteen minutes; 12 to 18 drachms, however, caused the animals to fall and lose consciousness and sensation; unconsciousness lasted three hours. Negotin recommended this method and dose.

Guinard found **morphine** useless in ruminants, and especially in goats; it failed to produce even a sedative effect. Goats are not injured by 400 times the full dose for man.

Malzew gave ten oxen **chloroform** in combination with **morphine**. Two or three grains of morphine were subcutaneously injected, and three to twelve minutes later chloroform was administered. In seven cases anæsthesia commenced after the lapse of ten to forty minutes, in three it could not be induced. From 4 to 19 fluid drachms of chloroform were used. On return of consciousness none of the oxen showed anything abnormal. Goats and sheep are easily anæsthetised in five to ten minutes with $2\frac{1}{2}$ to 5 fluid drachms of chloroform.

In general the above also applies to swine, and chloroform would probably prove the best material; Negotin found it harmless.

Harms succeeded in abolishing sensibility to pin-pricks in ten minutes by giving benzine vapour. Chloral hydrate is often given to cows when calving, in order to dull labour pains; complete anæsthesia is seldom necessary.

As, however, in the event of operation failing oxen may afterwards require to be slaughtered, alcohol is usually preferred to any substance which might taint the flesh. Most practitioners give a large dose of whisky or rum; in the case of oxen, one to two pints. In five to ten minutes the action begins, and as intoxication proceeds the muscles relax.

ANÆSTHESIA IN THE DOG AND CAT.

Ether or Chloroform may be used; the latter is preferable. Respiration may take place by either the mouth or nose, but it is dangerous to forcibly close the jaws, especially by muzzling the animal with tape. Guinard lays special stress on the need for keeping the dog's mouth open while giving chloroform; given by the nose alone chloroform is apt to produce so active a stimulation of the vagus as to sometimes inhibit the heart's action.

The dog is placed on its chest or side, the jaws opened, or fixed in an open position by a gag. Chloroform can be given by applying to the animal's nostrils a pad of tow or a small sponge moistened with chloroform. Another method is to form a cone of stout brown or blotting paper, at the bottom of which is placed a small loose ball of cotton wool to receive the chloroform. A conical muzzle, like Krohne's for human use, or an ordinary Junker's inhaler is probably the most convenient apparatus, though necessarily more costly than the paper cone. Whatever the method adopted, administration should always be slow.

Ether is given in a similar way, but the excitation period is longer, and the slumber produced less deep. On the other hand, ether anæsthesia may be prolonged for considerable periods without danger.

Hueppe claims to have produced anæsthesia in dogs by injecting $2\frac{1}{2}$ drachms of ether into the external ear.

To obtain more rapid narcosis, and diminish danger of collapse, **morphine** has been recommended in combination with **ether or chloroform**. Möller first injects from three quarters to one and a half grains of hydrochloride of morphine hypodermically, and after a short interval gives ether in the usual way.

Cagny administers ether vapour by the rectal mucous membrane. Its action, however, is uncertain, and it sometimes causes violent straining.

As in the horse, intra-venous injection of chloral is dangerous.

Morphine in the form of subcutaneous injection, and **chloral** in enema, have been advantageously combined. The dose of morphine is at the rate of two minims of a 2 per cent. solution, and of chloral seven and a half grains, per pound of body-weight. Roucher has slightly modified this method. The bowel is cleared with a soap and water or glycerine enema, and a subcutaneous injection of morphine in the proportion of $\frac{1}{50}$ th grain of hydrochloride of morphine per pound of body-weight administered, followed by an enema of one drachm of chloral hydrate in linseed emulsion. If necessary the dose may be repeated in seven to eight minutes; very large dogs may require a third, or even a fourth. The disadvantages are the same as in the horse. Anæsthesia is slow and hæmorrhage abundant.

Richet has recommended intra-peritoneal injections of chloral alone or associated with morphine. Injected into the peritoneum chloral produces complete anæsthesia in about ten minutes. The injection is made with a Pravaz's syringe, the greatest care being taken in regard to asepsis. When well diluted, chloral is tolerated by the peritoneum. Morphine added to the chloral prolongs anæsthesia to about one hour without danger of syncope. In this method the doses are, hydrochloride of morphine .02 grain, chloral four grains, per pound of weight. The method, however, does not seem to have proved permanently successful, dangerous complications sometimes occurring.

Fröhner regards urethane as one of the best agents for the dog, and has tried paraldehyde with good results. Desoubry gives from 22 to 30 grains of sulphonal to dogs of 40 lbs. body-weight, and highly praises the method.

In the dog and cat, however, the best method probably consists in using **chloroform** after a preliminary injection of **atropine** and **morphine**. The morphine modifies excitement at the commencement of anæsthesia; the atropine prevents cardiac syncope by suspending the function of the cardiac moderating centre and of the arresting fibres of the pneumogastric. The solution is prepared as follows:

Hydrochloride of morphine	.	.	.	3 grains.
Sulphate of atropine	.	.	.	·3 grain.
Distilled water	.	.	.	2½ fluid drachms.

This solution is injected in the proportion of five minims per

pound of body-weight. In twenty to twenty-five minutes the solution produces its effect, and chloroform inhalation can be commenced. A drachm or two is sufficient to produce complete anæsthesia, which can be prolonged for one or two hours. The solution used in man is as follows :

Hydrochloride of morphine	1½ grains.
Sulphate of atropine	·08 grain.
Distilled water	2½ fluid drachms.

This solution is also preferable for the dog. Ten minims are given to animals of small size, twenty to forty minims to animals of medium size, and sixty to eighty minims to large dogs. Chloroform is administered at the end of twenty-five minutes. This method produces deep and prolonged anæsthesia. There is no danger of syncope.

Langlois and Maurange recommend, for the dog, sparteine, morphine and chloroform. Fifteen minutes before inhaling chloroform, the dog is given a subcutaneous injection of sparteine sulphate ($\frac{1}{2}$ grain), and morphine hydrochloride ($\frac{1}{16}$ th grain).

The cat is very susceptible to the action of most anæsthetics. Death may result from giving an overdose, from pushing the anæsthetic rapidly, or from prolonging its action.

A convenient method consists in placing the animal under a bell-jar containing a small sponge or a tampon of wadding saturated with chloroform. The animal soon loses consciousness and falls, when it is removed and the operation performed. This method, however, is not without danger ; the period of anæsthesia is short, and if repeated inhalations are given there is some danger of the animal succumbing. A modified Junker's apparatus is preferable. Müller, of Dresden, confirms the common experience that cats are poisoned in a few minutes if chloroform be given rapidly, although they bear considerable doses of ether very well. Forty-five grains of chloral hydrate in the form of enema also proved fatal.

The combination of atropine, morphine and chloroform, as given above, may be employed, but the cat, being extremely sensitive to the action of morphine, which in it produces great excitement, the dose should not exceed ·002 grain instead of ·02 grain per pound of body-weight. Guinard recommends another method permitting of prolonged anæsthesia. He gives a hypodermic injection of hydrochloride of morphine at the rate of ·02 grain per pound of body-weight, and at the end of a quarter of an hour to twenty minutes, when excitement diminishes, he places the cat under a bell-jar with a sponge saturated with chloroform. The animal should be removed

when anæsthesia first appears, but inhalation is best continued for a few moments afterwards. Thus obtained, anæsthesia can be kept up for forty-five minutes. The excitement due to morphine reappears as anæsthesia diminishes, and may persist for some time.

Negotin recommends Billroth's mixture (chloroform 3 parts, ether and alcohol $\bar{a}\bar{a}$ 1 part) or Wachsmuth's (chloroform 5, rectified oil of turpentine 1 part) for dogs and cats. The ordinary A.C.E. mixture (ether 3, chloroform 2, alcohol 1) is better than equal parts of ether and chloroform.

Negotin had indifferent results in carnivora and horses with bichloride of ethylene, and in cats and dogs with bromoform.

Monkeys may be placed in a cage closely covered with a cloth, and containing in one corner a tampon of cotton wool saturated with chloroform. The animal at first struggles, and then begins to fall about the cage or to lean against the walls, at which stage it is removed; if the operation lasts for some time a further inhalation is given.

Birds may be placed under a bell-jar containing a sponge or cotton-wool tampon saturated with chloroform. One edge of the jar may be slightly raised to allow air to enter. Hering states that birds may be hypnotised by placing the head under one of the wings, and then rapidly turning the bird's body several times around its long axis.

Conclusions regarding General Anæsthesia. The above conclusions may be summarised as follows:—

1. For horses the best anæsthetic is chloroform (inhaled) in doses of 1 to 8 fluid ounces; average dose, say, 3 ounces.
2. For oxen: chloral hydrate, in doses of 12 to 20 drachms, or whisky, brandy, or rum in doses of 1 to 2 pints.
3. For sheep, goats, and swine: chloroform (inhaled) in doses of $2\frac{1}{2}$ to 5 drachms.
4. For dogs and cats: morphine (subcutaneously) in doses of $\cdot 75$ to 1.5 grains, or equivalent doses of morphine and atropine, followed by inhalations of ether, or chloroform given in small, carefully increased doses, or a mixture of chloroform, ether and alcohol.

LOCAL ANÆSTHESIA.

The dangers of general anæsthesia have stimulated the search for means of rendering insensitive the region of operation alone. Prolonged compression of tissues and mediate compression of the

nervous trunks supplying the part are very imperfect methods. For a long time ice refrigerating mixtures and ether spray were exclusively used. Cocaine was afterwards discovered, and soon became popular. Eucaïne, novocaine, and stovaine are also used; and when the operation is likely to be accompanied by moderate bleeding, solution of adrenalin is added to the anæsthetic before injection.

Anæsthesia by Cold. The prolonged action of cold renders superficial tissues bloodless and diminishes or even abolishes sensibility. Refrigerant mixtures have been used in operations like neurectomy.

Crushed ice and salt, mixed in the proportion of 2 to 1, are packed into a long bag and applied to the region of operation. In a few minutes, especially if the bag is pressed firmly into contact with the part, the skin becomes cold, firm, and insensitive, and incisions unless deep neither provoke pain or hæmorrhage. The anæsthesia, however, is of short duration, and operation must be rapid.

By projecting an ether spray on the parts the temperature is soon so far reduced that trifling operations may be performed without pain. The action is rendered more rapid and complete by previously applying an Esmarch bandage. It is difficult, however, to render inflamed parts insensitive, and for this purpose the usual refrigerating mixtures are preferable.

Methyl bichloride, successfully used in man for troublesome neuralgia, is almost too active, and though rendering the skin insensitive in a few seconds not infrequently freezes it, causing more or less extensive necrosis.

Local Anæsthesia by Cocaine. Cocaine is almost insoluble in water, but the greater number of its salts dissolve freely. The most frequently employed is hydrochloride of cocaine of 1 to 10 per cent. strength. The addition of a trifling amount of bichloride of mercury insures the solution keeping. Reclus recommends the following formula:

Hydrochloride of cocaine	.	.	1½ grains.
Sublimate	.	.	·03 grain.
Distilled water	.	.	2½ fluid drachms.

A few drops of this solution placed between the eyelids render the superficial layers of the cornea insensitive in three minutes.

By repeating the application at two-minute intervals the cornea, the conjunctiva, and eyelids are often completely insensitive in less than ten minutes, and anæsthesia lasts a quarter of an hour. The pupil dilates, but as a rule the iris is not rendered insensitive unless the injection is made into the anterior chamber. By this method puncture of the cornea and removal of foreign bodies fixed in the

conjunctiva are rendered easy. Five or six subconjunctival injections made around the ball of the eye permit the eye itself to be removed without great pain. Cocaine acts equally well on other mucous surfaces, and under certain conditions may be useful in painful inflammations of these membranes. The most recent experiments appear to show, however, that the blanching and anæsthesia are followed by congestion of the parts, and the use of cocaine in gargles, etc., for inflamed pharynx has been abandoned in human surgery, the after effects being bad. Solution of cocaine, 2 to 5 per cent., is frequently employed subcutaneously to assist in the diagnosis of obscure lameness in horses.

By a series of small injections along the course of a proposed incision operation is rendered painless, provided the seat of operation be in a mucous membrane or in the skin. A Pravaz's syringe fitted with a long fine needle is used, the needle being inserted into the subcutaneous connective tissue, or, better, into the thickness of the epidermis, following the direction of incision. As the needle is gradually withdrawn the piston is slowly pressed home, leaving the track filled with fluid. The anæsthetic qualities of cocaine are increased by previously injecting morphine. Its toxicity varies according to species. In the dog the dose varies from $\frac{3}{4}$ to $1\frac{1}{2}$ grains. Strong solutions offer no advantages and are dangerous. Cocaine solutions of whatever strength, lose, more or less completely, their anæsthetic quality on becoming acid, but this can be restored by neutralising the liquid.

Local Anæsthesia by Infiltration. Schleich produces local anæsthesia by causing artificial œdema in the region of the operation. He performed amputation and even laparotomy successfully. He showed that it is not necessary to inject strong solutions of the anæsthetics which might produce poisoning, but that quite weak solutions, even a .2 per cent. solution of chloride of sodium, suffice, and that in all cases of anæsthesia, other factors than the mere chemical constitution of the substance play an important part. The injection of fluids under fairly high pressure into the skin and subcutaneous tissues renders the whole area affected completely insensitive. Should the tissues be cut through no blood flows.

This method produces anæsthesia by the co-operation of four factors—the pressure induced by the mechanical action of the liquid, cold due to the temperature of the solution, anæmia caused by the cold and pressure, and a chemical change produced in the nerve endings. The undermentioned formulæ, which have been used in human practice, have been tried on horses and dogs by

Podkopajeu and Negri, who recommend them for their simplicity, harmlessness, and cheapness.

The condition lasts, however, for not longer than twenty minutes. Schleich's experiments showed that the best results attended the use of a combination of cocaine, sodium chloride, and morphine. He recommends the following formulæ for use in man :

Strong solution	{ Hydrochloride of cocaine	0·20
	{ Hydrochloride of morphine	0·02
	{ Chloride of sodium	0·20
	{ Water	100

7 fluid drachms injected at each operation.

Moderately strong solution	{ Hydrochloride of cocaine	0·10
	{ Hydrochloride of morphine	0·02
	{ Chloride of sodium	0·20
	{ Distilled water	100

14 fluid drachms injected at each operation.

Weak solution	{ Hydrochloride of cocaine	0·01
	{ Hydrochloride of morphine	0·005
	{ Chloride of sodium	0·20
	{ Distilled water	100

Use up to 140 fluid drachms at each operation.

He renders even the first prick of the needle painless by previously spraying the point of puncture with a mixture of four parts of sulphuric ether and one part of petroleum ether. Mucous membranes are rendered insensitive by dabbing with 10 per cent. carbolic solution, or with a solution of cocaine. The needle is slowly introduced into the skin itself in a direction parallel with the surface, and must not enter the subcutaneous tissue. As soon as the point has travelled a quarter to half an inch beyond the primary puncture the piston is gently pressed, causing a bleb to rise in the skin. The syringe is then slowly withdrawn, and again introduced within the periphery of the little blister previously produced. This is quite painless, as the area has now become insensitive. A further blister is thus produced, and the operator proceeds in the same way until a chain of blisters is formed covering the entire length of the incision presently to be made. Each of these points of artificial œdema is insensitive. The method succeeds, not only in the case of skin and mucous membranes, but in serous and synovial membranes, muscles, nerves, and the periosteum. Even bones and the bone medulla can be rendered insensitive by subperiosteal injections. Deeper-lying tissues can, of course, only be rendered insensitive after the more superficial have been so treated. The condition persists for fifteen to twenty minutes; should an operation last longer the process must be repeated. In preparing for the insertion of sutures for instance,

the needle of the syringe is passed from the cut surface towards the skin, so that the path which the suture needle will afterwards take is rendered œdematous. The bleeding from tissues thus rendered œdematous is remarkably slight; on incision the injection fluid is first of all discharged without admixture of blood, then little points of bright arterial blood appear in the fluid from the wound.

According to Schleich the injection of distilled water also induces local anæsthesia. A solution of .2 per cent. chloride of sodium sets up local anæsthesia without previous hyperæsthesia; 3 per cent. solutions of sugar produce more or less pronounced anæsthesia. Pietro Ghisicui has experimentally studied at the Turin Veterinary School the results obtained by the above-mentioned formulæ, and by distilled and sterilised water.

The quantity of cocaine solution or of distilled and sterilised water employed varied; generally he used from $2\frac{1}{2}$ to 16 drachms of the strong solution, 3 fluid ounces of the moderately strong solution, $4\frac{1}{2}$ fluid ounces of the weak solution, instead of $1\frac{1}{2}$ to $4\frac{1}{2}$ fluid ounces of water. He noted a fleeting hyperæsthesia during the operation, the tissues became turgescient, infiltrated, œdematous, and anæmic. The œdema produced by the water and by the solution of Schleich disappears after eight or nine hours. The vitality of the tissues is unaltered, and cicatrisation takes place regularly. Complications, such as stupefaction, nervous or functional troubles, etc., have not been observed.

From twenty-two experiments made with water, and the same number with Schleich's solution, the author draws the following conclusions:

Anæsthesia by infiltration should be more common in veterinary practice. Schleich's method is very useful, practical and cheap. Solutions of cocaine may be replaced by distilled and sterilised water, with which complete local anæsthesia is obtained, lasting as long as that produced by Schleich's solution. In laparotomy water and cocaine solutions have an unsatisfactory effect, apparently due to the ready distension of the tissues, which prevents the requisite action of the fluids.

Bayer tried Schleich's method in animals, and with such good results that he recommended it strongly, especially where casting the horse might be inadvisable. As an experiment, he made an incision about four inches long through the mucous membrane of the tongue and then sutured the wound. He also trephined the superior maxillary sinus without causing any apparent pain. The horse was operated on in the standing position, and was not restrained

by twitches or other appliances. In another case, having cast but not chloroformed or twitched the horse, he divided the median nerve without causing any struggle. In this instance the nerve sheath was injected. At the point of operation the nerve was insensitive, but pressure with the needle at any spot beyond the œdematous zone produced lively reaction. Employing infiltration Möller successfully performed an extensive operation for hernia on a horse without casting. This method is particularly useful in dogs, which seem specially susceptible to the action of chloroform, and not infrequently die as a consequence of prolonged administration.

SPINAL ANÆSTHESIA.

The event of the surgical year 1900 in Paris was undoubtedly the impetus given by Tuffier to the method of inducing anæsthesia by medullary injections of cocaine, a suggestion previously made and acted upon by Bier, of Kiel, Seldowitsch, of Russia, and Corning, of Chicago. Tuffier was first led to use it as a means of relief in the case of a young man suffering from an inoperable osteosarcoma of the ilium for which morphia had been employed without benefit. The result of the injection of cocaine was striking. The patient, who was crouching down in the position of greatest ease, felt the pain disappear in a few minutes, and was even able to rise. There was at the same time absolute anæsthesia reaching to the umbilicus. Unfortunately the relief lasted only a few hours, and the injection was repeated two days later with similar effect, pressure over the tumour for some hours causing no pain whatever. A few days later a similar injection was tried for a patient with a recurrent sarcoma of the thigh, and to Tuffier's surprise he was able to remove the tumour completely with absolutely no pain to the patient, the anæsthesia lasting over an hour. At first, therefore, used only in the surgery of the lower limbs, Tuffier rapidly extended its use to operations upon the perinæum, the rectum, the anus, the bladder, the ureter, the kidney, and such laparotomies as hysterectomy, removal of the appendix, and even gastro-enterostomy. Finally, removal of the breast has been effected with complete anæsthesia. Convinced of the absolute harmlessness of the injections, Tuffier then used them in general gynæcology, and performed such operations as hysteropexy, drainage of salpingitis, ovariectomy, vaginal hysterectomies, etc., with equal success.

Intra-spinal anæsthesia is now widely employed in human surgery. Cocaine has been replaced by stovaine, tropacocaine, or novocaine, and the injection is made up with sterilised water containing sodium

chloride, or five per cent. glucose, and sometimes a few drops of a weak solution of strychnine are added to counteract the depressing effect of the anæsthetic. To promote diffusion Barker and other English surgeons recommend that the density of the injection should be slightly greater than that of the cerebro-spinal fluid (1·0070). Lumbar anæsthesia has been tried in the horse, ox, and dog by Cuillé and Sendrail, of the Toulouse Veterinary School. They report that their experiments have given complete satisfaction.

Horse. They employ a trocar about 5 inches long by $\frac{1}{16}$ of an inch in diameter. The place where the puncture is made is found midway along a line joining the internal angles of the two ilia. Implanted vertically at this point the trocar enters the neural canal, traversing the lumbo-sacral space. It is the only accessible spot; further forward the vertebral laminæ are too close together or imbricated. Penetration of the subdural space is indicated by the escape of cerebro spinal fluid through the cannula. During the operation the animal scarcely moves. The application of a twitch and the lifting of a fore-foot are the only precautions required. Disinfection of the cutaneous surface, sterilisation of the trocar, syringe, and solution, are absolutely necessary.

First experiment. Aged mare. Injection of 1 fluid drachm of 2 per cent. solution of cocaine. Five minutes later the subject rocked slightly; when made to move she showed weakness behind, and went over on her side. The students practised neurectomy on all four legs. Cutting through the nerves of the hind-limbs caused no pain, but section of the nerves in the fore-limbs produced pain, manifested by struggling of all the limbs.

In the second case the operation of ovariectomy was performed without any exhibition of pain.

Third experiment. Aged mare, medium size. Injected 30 minims of cocaine solution. The gait was like that of the former animal. Ten minutes later ovariectomy was performed without any movement whatsoever ("dans le calme le plus parfait"). The sensibility of different parts of the hind-limbs, flanks, and lower aspects of abdomen was tested by pyropuncture; there were no signs of pain. Plantar neurotomies were performed upon the hind-limbs forty minutes after the injection without pain, the animal lying down.

Bovines. The same trocar as for the horse was used. Puncture was made at the same point. Leaving aside the toughness of the skin, the operation is easier than in the horse, the lumbo-sacral space being a little wider.

Sixth experiment. An old Lourdes cow. Injected 75 minims

of 2 per cent. solution of cocaine. Three minutes later the animal flexed her hind-limbs; after five minutes she showed weakness, and for a short time literally sat down; then she lay down on her side. Pricked deeply in different parts of the hind-limb, she did not move. When the prickings were done in the fore-quarters as far as the line of cartilages of the asternal ribs, she showed pain. An hour later the animal got up voluntarily. The spinal cord, spinal meninges, and cauda equina were perfectly normal.

Dog. The best point for the operation is again in the lumbo-sacral region, taking the same landmarks as before. A hollow needle of a Pravaz syringe, $2\frac{1}{4}$ inches long and $\frac{1}{32}$ inch in diameter, is the most suitable.

Ninth experiment. A male mastiff of average size received 30 minims of the cocaine solution. The animal stood up, the head being kept firmly in position by an assistant, and did not resist the operation. Several minutes later he fell upon his hind quarters with the limbs extended, and progressed by means of the fore-limbs as an animal attacked with complete paraplegia. Sensibility was tested by the aid of the zoocautery, and was found to be non-existent behind the hypochondriac regions, but preserved in front. Forty-five minutes later the animal got up, and sensation only commenced to reappear at the end of an hour. The dog then went to his kennel and ate his food with relish.

Tenth experiment. Made upon the same animal the day following the previous experiment. The animal did not appear to have suffered from the experiment of the previous evening. He received 15 minims of the solution. Five minutes later the gait was somewhat altered, but walking was still possible; the analgesia extended over the same area as on the previous day. An hour later, the condition of the animal being apparently normal, 15 minims were injected in the region of the bulb in the occipito-atloid space without puncturing the medulla. A few seconds later the animal became helpless; he could only advance by crouching on the ground with his paws in front of him, moving upon his sternum. He vomited. The analgesia involved the anterior part of the body, the head excepted. Two hours later he progressed more easily, and went to his kennel, where he ate his food. During the succeeding days and for a month afterwards he showed nothing abnormal. Killed at the end of the month, no trace whatever could be found of the injections. All his organs were perfectly healthy.

These and other experiments show in a convincing manner that limited anæsthesia produced by cocaine injected into the neural canal is applicable in veterinary surgery, and that, with proper

precautions, there is no danger. The doses used were fifteen to seventy-five minims of a 2 per cent. solution of cocaine for the horse or ox. For dogs fifteen minims should not be exceeded. Solution of stovaine (5 per cent.), dog, M. 20 to M. 30 ; Cat, M. 10 to M. 20 ; horse, ʒj to ʒjss.

IV.—ANTISEPSIS AND ASEPSIS.

DURING the first half of the last century infection of exposed wounds was attributed to impure and exhausted air, especially to the hospital atmosphere and to air charged with the miasma of putrefaction. Pasteur and Tyndall corrected the truth of this idea, and showed that it is not the air itself which has injurious properties, but only the germs it carries in suspension. Sterile organic fluids exposed to the atmosphere immediately begin to ferment, but provided they be kept from contact with all but optically pure air filtered through cotton wool they undergo no change. It was therefore concluded that decomposition and putrefaction are due to little animate bodies, suspended in the atmosphere,—*i.e.* germs or microbes—which under favourable conditions break down organic substances. Save for micro-organisms there would be no decomposition and no putrefaction. Extending the logical process, Lister was of opinion that the same changes went on in injured tissues exposed to the action of air as occurred in organic liquids. Septic changes in wounds therefore represent a kind of fermentation.

In 1865 Lister, inspired by Pasteur's work on fermentation, began those experiments which eventuated in the formulation of his "antiseptic method"; while in 1870 Guérin, following up the same work and that of Tyndall, invented his surgical dressing.

Guérin applied to wounds the experimental conditions necessary for preserving organic materials from change when in contact with the air, shielding the injured tissues by thick layers of cotton wool. Lister, on the other hand, sought to destroy microbes present in the wound or introduced during operation, by means of chemical substances. Lister first rendered the wound aseptic and afterwards protected it by a germicidal barrier.

At first Guérin did not seek primary union of the wound, only attempting to reduce the discharges and to avoid infection. Bleeding having ceased, he washed the wound with tepid water, afterwards with a mixture of water and camphorated alcohol. In some cases he sutured the wound and cut the threads short, covering the parts with several layers of wadding. In extensive operations on the

limbs the region was enveloped in many layers of wadding suitably affixed. The outer bandages were applied tightly, and if during the next few days the degree of compression was considered insufficient, or if the discharges penetrated the whole thickness of the wadding, fresh bandaging was resorted to. At first the dressing was left in position for twenty to twenty-five days, later it was replaced at the end of twelve to fifteen days. As a rule on removing the first dressing the wound was found to be granulating throughout. With a second dressing left in position for eight to ten days cicatrization was complete.

To obtain primary union various modifications were made in this method. Thus bleeding was more thoroughly checked, and the lips of the wound carefully closed with deep sutures of some material like catgut which would gradually disappear. Despite its many advantages this dressing of cotton wool concealed the state of the wound. The thermometer certainly gave indications of unfavourable changes, but as considerable fever sometimes occurs even when wounds are doing well, time was lost, and it was not infrequently necessary to remove the dressings, thus exposing the patient to danger. Further, although atmospheric germs could not enter the wound through the layers of cotton wool, those already there or introduced during operation were not destroyed, and frequently multiplied with great rapidity.

Compared with the older dressings that of cotton wool constituted an immense stride in the surgical art, but, nevertheless, its use did not become general. The greatest success was reserved for Lister's dressing, which was more practical and also more certain in its results.

To prevent infection Lister sought to destroy all infectious materials in and around the wound as well as in the neighbouring air. Completing this process, he took care that the hands of the surgeon and his assistants, the instruments, sponges, compresses, and all materials used as dressings should be rendered thoroughly aseptic. The wound having been cleansed of organisms was covered with a material saturated with an antiseptic, and precautions taken to prevent accumulation within it of serosity from the injured tissues.

Lister long preferred carbolic acid in solutions of 1 in 20 and 1 in 40. With the strong solution the instruments, sponges, and seat of incision were disinfected, and once the operation was over, the wound throughout. The weaker solution was used for disinfecting the hands of the surgeon and his assistants, and for rinsing sponges and instruments during operation. To prevent the wound being

infected by atmospheric germs he introduced an antiseptic spray, the vapour of which covered the entire area of operation. All bleeding was checked, vessels were ligatured with catgut, the threads were shortened, and the edges of the wound brought together with catgut sutures. Rubber drain-tubes were inserted to permit serosity, etc., to escape, and the dressing was then applied.

The region of operation was first covered with a strip of protective consisting of oiled silk, the object being to prevent prolonged action of the carbolic solution on the wound, as this proved too irritant. Over the protective was applied carbolised gauze, doubled six or eight times, the last two layers being separated by a layer of mackintosh to prevent the carbolic acid evaporating, and to force the wound discharges to traverse the entire thickness of the dressing before escaping. All these materials were fixed in place by bandages of carbolised gauze.

Lister's method of dressing rapidly spread throughout all Continental countries. Though it at once displaced the old methods, it possessed some drawbacks, such as the minuteness of detail required, the time demanded for its application, its high price, and the dangers resulting from the poisonous nature of the antiseptic employed—carbolic acid. While, therefore, respecting the great principles laid down by the founder of the method, surgeons set to work to perfect and especially to simplify its application. Carbolic acid was replaced by salicylic acid, thymol, zinc chloride, corrosive sublimate, bismuth subnitrate, iodine, iodoform, and other antiseptics. Ordinary tarlatan or muslin, soaked for a week in carbolic solution, was substituted for carbolised gauze. The spray was discontinued as superfluous. Drainage tubes of decalcified bone were suggested, because they became absorbed, irritated the tissues little, and necessitated less frequent renewals of the dressing. The protective was shown to be useless, and drainage was suppressed except when immediate union appeared uncertain. The technique of dressing, the antiseptics, and the strength of solutions have been varied infinitely.

Believing that the principal point was to prevent atmospheric germs gaining access to the wound, Guérin paid less attention to disinfecting hands, instruments, and dressings, and his good results were in a large measure due to the habit he had formed of thoroughly washing the hands and cleansing the region of operation and its neighbourhood with soap and camphorated alcohol before operation. In Lister's practice, the most important factor was the rigorous cleanliness of the hands, of the instruments, and of the

dressings. Antiseptic treatment of wounds might never have survived had not observance of cleanliness largely assisted it. Contrary to the belief generally held when antiseptics was introduced, entrance of air into wounds is little to be feared, and atmospheric germs can be almost disregarded. In veterinary surgery asepsis will probably never obtain the same favour as antiseptics. Strictly considered, however, antiseptics and asepsis do not stand in opposition, but rather form mutual complements of each other; aseptic methods being preventive, antiseptic curative, their association is often advantageous. Antiseptics are resorted to when the region of operation includes a suppurating wound, a fistula, or an ulcer, or when reunion by first intention has failed. Antiseptics are then employed to disinfect the seat of operation, the hands, the instruments, and the dressing materials. The aseptic method, on the other hand, is applicable to operations on infection-free tissues which might become inflamed under the action of antiseptics, to cases of limited necrosis and to intoxications; but if asepsis can be ensured, it is useless to apply to healthy tissues strong antiseptic solutions. Of the two principles—"antiseptics before and during," "antiseptics before, asepsis during"—the former is preferable in our practice on account of the chances of the wound, the hands, and instruments becoming infected during operation. Even in human surgery, where, thanks to better surroundings and to special apparatus, rigorous asepsis can much more readily be obtained, and where the operator can count on highly skilled assistants, antiseptics nevertheless has many adherents.

Wound infection is caused by the presence of pathogenic bacteria, which sooner or later develop and multiply, and by their activity or their products set up irritation of the tissues, inflammation, suppuration, and in certain cases, general infection of the body. Among the micro-organisms causing surgical infections micrococci and bacilli stand pre-eminent. Whilst the former are usually quickly killed by heat and the principal disinfectants, the latter resist to a varying degree, depending on whether they are present in the form of rods or exist as spores. The adult bacilli are easily killed, the spores on the other hand are strongly resistant. Certain spores, like those of tetanus and anthrax, exhibit most extraordinary vitality.

When dry, microbes resist the action of heat and antiseptics to a higher degree and for a longer time than when moist. The most convenient method of destroying them is exposure to moist heat. Whilst steam at 212° F. kills the majority of pathogenic microbes,

the dry temperature required for the same result varies from 290° to 330° F. Moisture considerably enhances the destructive action of high temperatures and of antiseptics. Few pathogenic microbes resist steam heat for more than a few minutes. Many die at 175°, 160°, and even 150° F., but the spores of the tetanus bacillus and of some septic organisms endure higher temperatures than 212° F. without destruction. The following table shows the temperatures at which the organisms of chief surgical interest are destroyed :

<i>Staphylococcus pyogenes aureus</i> is destroyed in ten minutes by a temperature of					137° F.	
"	"	<i>albus</i>	"	"	"	144° F.
"	"	<i>citreus</i>	"	"	"	144° F.
Streptococcus of erysipelas		"	"	"	"	131° F.
"	strangles		"	"	"	140° F.
The bacillus of tetanus		"	"	"	"	167° F.
"	"	tuberculosis	"	"	"	176° F.
"	"	glanders	"	"	"	131° F.
Anthrax spores are destroyed in ten minutes by a temperature of					212° F.	
Tetanus spores					220° F.	

Tetanus spores are destroyed in fifteen minutes by a temperature of 212° F. and in five minutes by a temperature of 240° F. At ordinary temperatures they resist 5 per cent. carbolic solution for more than ten hours. The organism of black-quarter is destroyed in ten minutes by immersion in boiling water. When dry it resists a temperature of 250° F. for ten minutes. Moist anthrax spores are destroyed in a few minutes by a temperature of 212° to 220° F. When dry they are only killed after ten minutes' exposure to a temperature of 240° F.

Bacteriological researches and some clinical investigations show that disinfection by chemical agents is not always complete even when concentrated solutions are used. Organic substances, even in thin layers, are not always readily penetrated by liquid antiseptics, and the deeper strata may retain virulent organisms in spite of the prolonged action of such liquids. Chemical disinfectants are therefore reserved for the seat of operation, and the hands ; instruments, ligatures, drainage-tubes, and other materials used for dressing are subjected to the action of boiling water, glycerine, heated oil, or simply to a high degree of dry heat. The simplest and most practical method is that of boiling in water containing one per cent. of sodium carbonate. Although it does not give absolute security—certain spores resisting even a temperature of 212° F.—it is almost always sufficient.

ANTISEPTICS.

Carbolic acid is used in solutions of 1, 2½, and 5 per cent. strength. The 5 per cent. is mainly employed for disinfecting the hands, instruments, seat of operation, abscess cavities, suppurating wounds, and sometimes for exciting slight adhesive inflammation when inserting intestinal sutures. It is unsuitable for operation and recent wounds, because it strongly irritates the tissues and produces free serous exudation, thus impeding immediate union. The 2 per cent. solution is suitable for irrigating fresh wounds, and for rinsing the hands during operation. The 1 per cent. solution is used for disinfecting certain mucous surfaces and for obstetrical operations.

Sublimate or perchloride of mercury solution is one of the most useful chemical antiseptics. A 1 in 1000 solution destroys bacteria and most micro-organisms in a few minutes (Koch). On account of its irritant and toxic characters many surgeons restrict its use to the disinfection of the skin and vaginal mucous membrane. For other mucous surfaces and for deep wounds they regard it as dangerous. Nevertheless, in weak solution it is valuable for irrigating surgical and accidental wounds, as it irritates tissues less than carbolic acid. It blackens metallic instruments, destroys their polish, and injures their edge. The strong solution of sublimate is prepared as follows :

Sublimate	.	.	.	.	.	.	1 part.
Tartaric acid	.	.	.	.	.	.	5 parts.
Boiled water	.	.	.	.	.	.	1000 „

The weak solution contains double the above quantity of water. Solutions of 1 in 3000 to 1 in 5000 can be used for most mucous membranes. As, however, it is decomposed by alkaline salts, distilled water must be used for making solutions, or a small quantity of acetic or salicylic acid should be added to ordinary water before use. To prevent sublimate solutions being decomposed by contact with albumen, five parts of chloride of sodium or ammonium to each part of sublimate are added in preparing them. A convenient method of preparing sublimate solutions is offered by the tablets, etc., manufactured by various wholesale chemists. An excellent material for disinfecting the surgeon's hands is obtained by dissolving two parts of sublimate in 1000 parts of rectified spirit. Frick's wound gelatine for covering wounds after operation is prepared by soaking gelatine in 1 in 1000 sublimate solution, dissolving by heat, and adding a quantity of glycerine equal to one-tenth of the weight of the dry gelatine. It adheres better than collodion.

Chloride of zinc, formerly used for treating unhealthy wounds, is a powerful antiseptic. In 5 per cent. solution it rapidly destroys most spores (Koch), but it is caustic. The 10 per cent. solution is useful for disinfecting fistulæ, abscesses, and suppurating or septic wounds.

Socin's paste, consisting of 50 parts oxide of zinc, 50 parts water, and 5 parts chloride of zinc, is used in veterinary practice; applied to aseptic sutured wounds it forms a kind of protective varnish, replacing a dressing. It is specially useful for wounds about the head and in the upper regions of the body.

Potassium permanganate is also a good antiseptic, devoid of toxic properties. It owes its microbicidal powers to the oxygen which it disengages. Producing no irritation it can be used for all wounds, especially those in mucous membranes. A solution of 1 in 1000 is useful for disinfecting the mouth, nasal cavity, vagina, rectum, and serous cavities. A 10 per cent. solution is used for infected wounds and occasionally for the hands. The stain can be removed by plunging the hands into a 10 per cent. solution of hyposulphite of soda to which has been added a few drops of hydrochloric acid.

Hydrogen peroxide is a powerful germicide. Mixed with blood or pus it decomposes with effervescence, and is of considerable value as a disinfectant for sinuses and abscess cavities. With normal saline solution hydrogen peroxide is a useful hæmostatic.

Bichloride of mercury is stated to be thirty times more active than sublimate, and a solution of 1 in 10,000 to 1 in 20,000 is used for disinfecting the vagina and mucous membrane of the uterus. This solution neither irritates the hands, nor the lips of wounds, and does not injure instruments.

Iodine is a very active antiseptic; one part in 7000 destroys both bacilli and their spores (Koch). Iodine, dissolved in chloroform or ether, or as the tincture is largely used for disinfecting the skin prior to operation. Solutions are employed as injections for bursal distensions after evacuation of the contents, and the undiluted tincture is an excellent application for offensive wounds and abscess cavities.

Iodoform, long employed for treating wounds and ulcers, is especially useful in checking suppuration. Its action is slow. Being both antiseptic and analgesic it assists cicatrisation, retards decomposition of wound discharges, and diminishes pain. Powdered over the lips of wounds before suturing it does not prevent immediate union. Dusted in a thin layer into wounds with loss of substance it keeps them aseptic for 5, 6, or 7 days, constituting a kind of disinfecting reserve. Its disadvantages are its disagreeable odour and high price.

Three preparations of iodoform are used in surgery, viz. saturated solution in ether, a 10 per cent. emulsion in glycerine, and a 10 to 20 per cent. ointment in vaseline. The glycerine emulsion is useful in the treatment of abscesses, tuberculous cavities, and contused wounds, like those caused by carriage poles, etc. Gauze and wadding impregnated with iodoform are largely used as antiseptic dressings. They contain 10, 20, and 30 per cent. of iodoform.

Formalin consists of a 40 per cent. aqueous solution of formaldehyde. Diluted with four to five hundred parts of water, it becomes a useful disinfectant for the hands, seat of operation, and accidental wounds. Strong solutions are irritant and caustic. **Tannoform**, **glutol** and **amylform** are respectively compounds of formaldehyde with tannic acid, gelatine, and starch. They form useful dry dressings for open wounds, but are of greatest service when preceded by the application of a liquid disinfectant.

Chinosol is a yellow, crystalline powder, derived from coal tar. A solution of one part in forty thousand prevents bacterial development, and a grain dissolved in six drachms of water is said to be equal in antiseptic powder to a $2\frac{1}{2}$ per cent. solution of carbolic acid. Solutions for surgical purposes vary in strength between 1 in 1200 and 1 in 60. Combined with starch or French chalk chinosol forms an efficient dry dressing.

Nitrate of silver of a strength of 1 to 2 per cent., or of 1 per 1000, is used with success for disinfecting certain inflamed mucous membranes.

Boric acid is little used in solution, but as a dry powder is widely employed for dressing wounds after operation. Its irritant properties are slight, and being non-volatile its action is long continued. A saturated solution is of great value for operations on the eye, and for disinfecting the mucous membranes of the buccal and nasal cavities, the rectum, vagina, and bladder.

Naphthol of a strength of 1 in 1000 is a feeble antiseptic. **Naphthalin** has the same properties as naphthol, exercises a stimulating action on the tissues, and promotes granulation of wounds. **Camphorated naphthol** is a yellowish-brown, syrupy liquid, produced by triturating one part of naphthol with two parts of camphor. **Camphorated salol** is an opalescent liquid, produced by warming together equal parts of salol and powdered camphor. **Camphorated thymol** is an almost limpid fluid, produced by triturating one part of thymol with two parts of camphor. These three products are used in treating suppurating wounds. Other valuable antiseptics are Lysol, Cofectant, Sanitas-bactox, Izal, and Creolin.

Sterilised salt solution consists of boiled water containing 80 grains of pure chloride of sodium per pint, and is very useful in washing out the abdominal cavity during or after operation.

The number of antiseptics increases every day, but the more recent have no marked superiority over those mentioned. Carbolic acid, corrosive sublimate, chloride of zinc, iodine and iodoform still maintain their position. In selecting an antiseptic preference should be given to one that does not irritate the tissues, that does not readily poison, and that destroys all micro-organisms. Warm or hot solutions of antiseptics are always more efficient than cold.

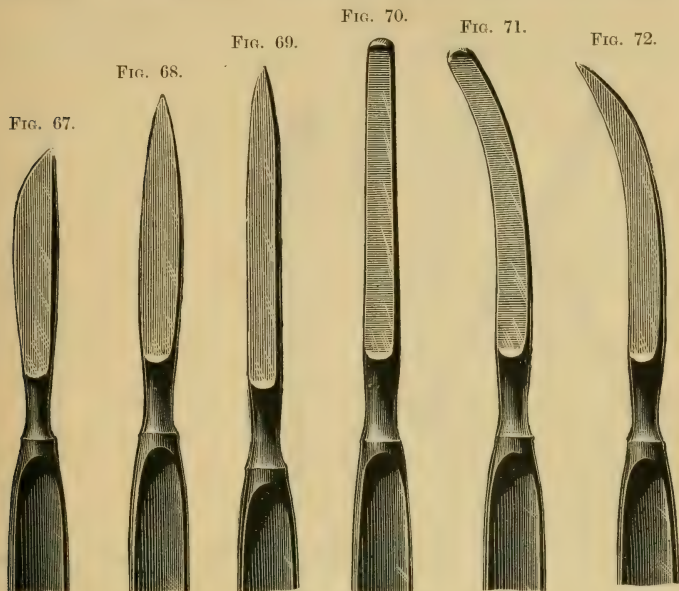
Disinfection of the Hands. Fürbringer's experiments have shown how difficult it is to render the hands aseptic. The matter is, however, of the highest importance, as the operator's hands are not infrequently the means of infecting operation wounds, and the surgeon who desires to avoid after-complications will take especial care in this respect. The spaces beneath the nails, the folds of skin at their base, the folds of the skin itself, and the orifices of skin-glands are all refuges for microbes, to destroy which demands the most minute precaution. In some cases it is impossible to render the hands completely aseptic. Kümmel and others have shown that after soiling with pus or with putrid or septic liquids from infected wounds or dead bodies, it is impossible to render the hands absolutely sterile for forty-eight hours. The surgeon should bear this in mind when arranging to perform laparotomy, ovariectomy, or cryptorchid castration. He should either defer operation for some days or redouble his precautions; neglect in this respect explains failure where apparently all the conditions for success have been present. The nails should first be cut short, and all foreign material mechanically removed from under and around them. The hands and forearms should next be washed for some minutes with soap and warm water, and scrubbed thoroughly with a brush or a Turkish flesh glove. They are then washed with rectified spirit, and lastly with 1 in 1000 solution of sublimate. The alcohol dissolves fatty materials which would otherwise impede the action of the antiseptic, and enables the latter to penetrate some distance into skin ducts, etc. More complex methods have been suggested, but the above is sufficient. In veterinary surgery the precautions usually taken extend only to thoroughly cleansing nails, washing the hands with hot water and soap, and thoroughly rubbing them with 1 in 1000 sublimate solution or 5 per cent. solution of carbolic acid. The hands must be rendered aseptic and kept aseptic throughout the operation. For this reason the operator should

avoid touching the skin surrounding the point of operation, the table, the straw or any object which has not been disinfected. Even when nothing suspicious has been touched, it is well during operation to rinse the hands from time to time in a disinfectant; should the hands actually have been soiled, they must immediately be cleansed again.

Disinfection of Instruments. The handles of modern instruments are generally made of German silver, nickel, or aluminium. They should present no unnecessary ornamentation, depressions, grooves, corrugations, or spots likely to hold dirt. Instruments like scissors, forceps, etc., should be capable of disarticulation for cleansing purposes, and complicated instruments difficult to clean should be discarded. Wherever possible instruments should be in one piece, like the retractors in Figs. 77, 78, and 79; for more complicated instruments the French joint, as shown in the lion forceps, Figs. 80 and 81, is the best. For sutures, Largu's or Mooij's needles are preferable to others, being simple and readily sterilised. For syringes with pistons one can often substitute a simple glass tube carrying a rubber ball, the piston being then replaced by a column of air. Many methods and materials for rendering instruments aseptic have been recommended. Immersing the instruments for a minute in pure carbolic acid and afterwards rinsing them in a 5 per cent. carbolic solution is advised by many surgeons. Boiling in water is a simple and practical method; and any detrimental effect on the blades can be prevented by adding one per cent. of sodium carbonate. Where a higher temperature of 250° to 260° F. is required the bath may be of oil or glycerine. The vessel in which this boiling takes place should be provided with a tight lid, so that after boiling the whole may be placed on one side to cool. Immediately before operation the instruments are removed from it, and placed in trays containing an antiseptic solution (3 per cent. carbolic), in which they remain until required for use. Should the operator have finished with an instrument for the moment it should be rinsed in a separate vessel and then returned to the solution, and never allowed to come in contact with the straw or be laid on the animal's body. Trays of glass or porcelain are very useful, though vulcanite is also largely employed, being much less brittle. All vessels of the kind must be subjected to a thorough cleansing before use. As instruments with wooden handles are damaged by boiling, they should be disinfected by cleansing and prolonged immersion in five per cent. carbolic solution. They should not be used in aseptic surgery.

Autoclaves, steamers, or stoves are only used in the laboratory or in hospital practice.

Disinfection with burning alcohol is another rapid method of disinfecting instruments. The instruments are placed on a metallic



FIGS. 67-72.—Scalpels.

plate previously rinsed with a little alcohol, which is then ignited. A few minutes suffice to render them sterile, when they can be placed in a weak antiseptic solution or in boiled water. Although



FIG. 73.—Dissecting forceps.

excellent for *écraseurs*, forceps, directors, etc., this method is apt to damage the temper of bistouries, scalpels, and scissors.

Gum-elastic probes are washed in strong alcohol and afterwards in 1 per 1000 sublimate solution.

In addition to instruments the surgeon employs sponges, tampons

of cotton or tow, compresses, suture threads, and various dressing materials. All such materials should previously have been rendered aseptic. After having been used, sponges are washed in running water, placed for ten to twelve hours in a 1 in 1000 solution of permanganate of potash, washed in boiled water, and afterwards placed in strong carbolic solution, where they should remain for at least two to three weeks. Immediately before use they are washed

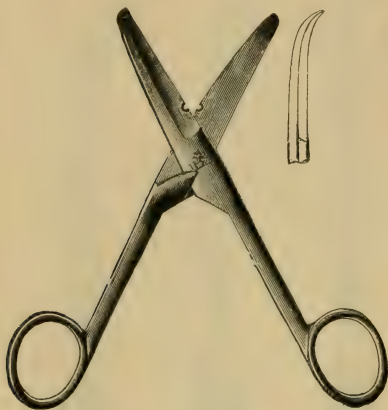


FIG. 74.—Curved scissors with German aseptic joint.



FIG. 75.—Curved scissors with French aseptic joint.



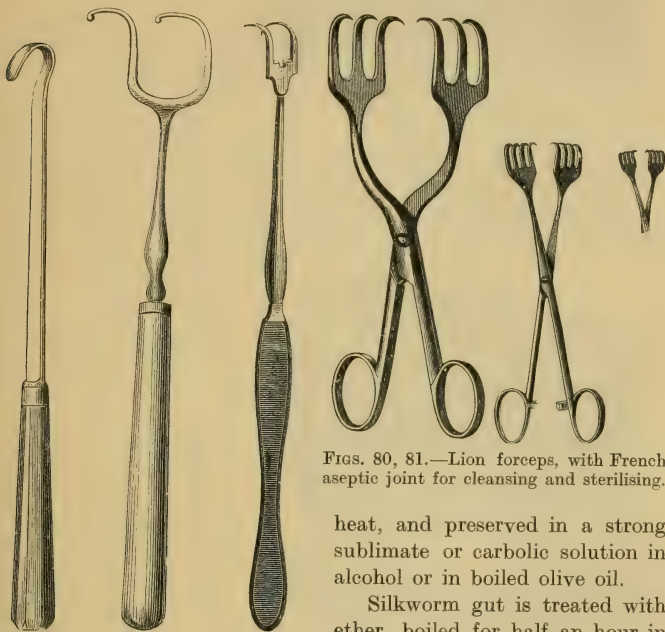
FIG. 76.—Straight scissors with French aseptic joint.

in boiled water, to remove the excess of carbolic with which they are saturated. For some time sponges have given place to compresses of gauze or sponge tissue sterilised in the autoclave, and tampons of absorbent wool. Many veterinary surgeons still use tow. This is unsuitable unless it has been thoroughly cleansed and sterilised by heat or by immersion in a boiling antiseptic solution. When used the method generally adopted is to plunge the tow for five minutes into boiling water or into a boiling soda solution.

Silk thread is sterilised by immersion for half an hour in boiling

water, or by exposure to a temperature of 220° to 230° F. in the autoclave. Immersion for a quarter of an hour in strong carbolic solution is also sufficient. It is preserved in glass holders (see Figs. 84—87) in 5 per cent. carbolic solution, or in 1 in 1000 sublimate solution.

Catgut is deprived of adherent fat by immersion in ether, and after drying is wound on bobbins. These can be sterilised by dry



FIGS. 80, 81.—Lion forceps, with French aseptic joint for cleansing and sterilising.

FIG. 77. FIG. 78. FIG. 79.
Retractors with metal handles for aseptic surgery.

heat, and preserved in a strong sublimate or carbolic solution in alcohol or in boiled olive oil.

Silkworm gut is treated with ether, boiled for half an hour in water, and then placed in tubes containing 2 per 1000 solution of sublimate.

Paraffined thread is prepared by immersing hemp thread, previously saturated with ether or oil of turpentine, in melted paraffin. To remove any stiffness it may be passed through a cloth before use. This thread is flexible, nearly impervious to organic liquids, and does not cut out rapidly. It is, therefore, especially useful for sutures intended to remain long in position.

Chinese twist, chromicized gut, tendon, horse hair, silver wire,

and other suture materials may be obtained ready for use from the instrument makers.

Drainage-tubes are preferably made of red rubber. After



FIG. 82.—Steam steriliser for instruments (packed for transport).

thorough washing in concentrated permanganate of potash solution they are left for twenty minutes in boiling water, transferred to tubes containing 2 per 1000 solution of sublimate, and finally sterilised by exposure to a temperature of 120° for

half an hour. They are sometimes replaced by bundles of aseptic silk or catgut, along which drainage proceeds, or by slips of gauze.

The **field of operation** and surrounding parts must be most carefully cleansed. In all animals the skin is covered with extremely

numerous and varied micro-organisms, among which staphylococci are particularly abundant. It is, therefore, always important to disinfect the parts. If the skin is healthy, the hair is removed with scissors or a clipping machine, the parts thoroughly soaped, shaved, scrubbed, and washed with boiled water. After being dried with a sterilised compress, the parts are rubbed with alcohol or ether to remove fatty materials from the surface, and are finally

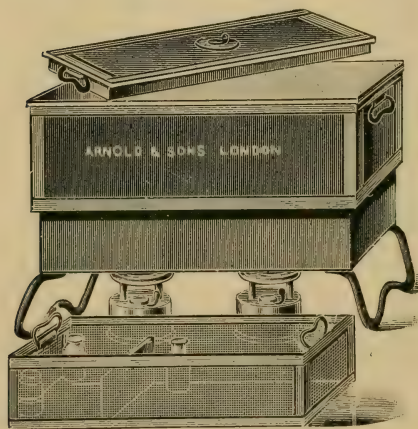


FIG. 83.—Steam steriliser for instruments (open in use).

washed with iodine dissolved in chloroform, strong carbolic, 1 in 1000 sublimate solution, or douched with tincture of iodine. If the skin is infected or the seat of an ulcer, suppurating wound, or fistula, it is necessary, the day before operating, or even some days in advance, to curette the wound, afterwards proceeding as just indicated. In abdominal operations, exposing the peritoneum, special care must

be taken to shave and disinfect a large surface, while the operative area should be covered with towels recently boiled or soaked in an effective disinfectant. Convenient irrigators for holding the above disinfectant solutions are shown in Figs. 89 and 90.

These two principal methods, however, are not applicable to all surfaces. They may require modification in certain regions. In all mucous membranes it is necessary to remove the mucus from the surface by freely washing with boiled water in order to permit antiseptic solutions to act more intimately.

The mouth is always infected with micro-organisms, and is difficult to disinfect. In large animals disinfection is confined to washing freely with water followed by 2 to 4 per cent. solution of boric acid, 1 in 1000 of permanganate of potash, or 1 per cent. of chloral hydrate. In the dog decayed teeth should be removed, and, if necessary, the gums swabbed with tincture of iodine or solution of hydrogen peroxide.

To promote intestinal antiseptis previous to intra-peritoneal operation, the bowel should be emptied by a purgative, the animal placed on a reduced diet, while antiseptic substances can be administered by the mouth. Saline purgatives in small repeated doses are valuable as a preparation, after which naphthol, or salol may be given

in the proportions of five to fifteen grains for small animals, and one and a half to six drachms for the horse and ox. Rectal injections of a solution of 1 in 1000 permanganate of potash, 1 to 2000 sublimate, or 4 per cent. boric acid, complete the preparation. When, during operation, the bowel is divided, the ends withdrawn from the peritoneal cavity are kept closed by clamps or by pressure with warm sterilised compresses, care being taken to avoid soiling the peritoneum by material escaping from the incision; the bowel must not be returned, until it is certain that the wound has

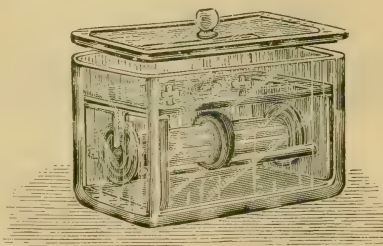


FIG. 84.—Silk-holder for hospital use.

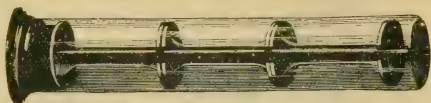


FIG. 85.—Portable silk-holder.

been completely closed and the serous coats around the suture touched with a strong carbolic solution in order to produce a slight adhesive inflammation. For eight to ten days after operation only small quantities of liquid nourishment, such as milk and beef-tea for small animals and hay-tea for others, should be given. Ordinary food is then gradually resumed.

In disinfecting the rectum, the food is diminished for several

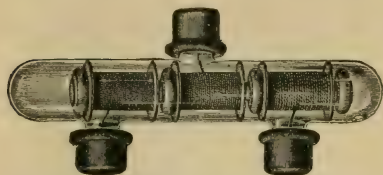


FIG. 86.—Sterilised silk in portable sealed tubes.

days in advance, and the same materials are prescribed as for intestinal antiseptic. In addition, however, the rectum must be frequently irrigated. The anus is disinfected in precisely the same way as the healthy skin.

The nasal cavities can be rendered aseptic by washing out with sterilised lukewarm water, and afterwards by injecting a 1 in 5000 solution of sublimate or a 1 in 1000 solution of permanganate of potash.

The eye demands special precautions. It can be bathed with normal saline solution, 4 per cent. boric solution, or the following solution of biniodide of mercury recommended for man by Panas :

Biniodide of mercury	5 to 10 centigrammes.
Absolute alcohol	20 grammes.
Boiled filtered water	1000 grammes.

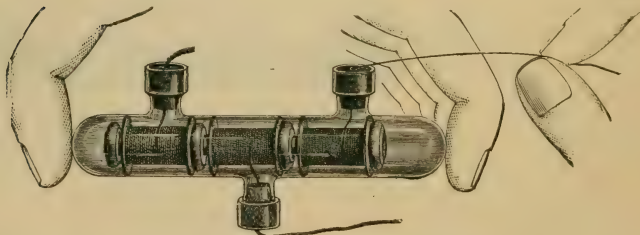


FIG. 87.—Showing method of withdrawing silk.

Sublimate must also be greatly diluted (1 in 5000). The instruments must be perfectly sterilised, especially if the globe of the eye is to be opened.

Disinfection of the external auditory meatus is carried out with

weak antiseptic solutions. The lining is cleansed with warm water and soap, dried, and irrigated with 3 to 4 per cent. boric acid solution, 1 in 1000 permanganate of potash, or 1 in 5000 sublimate solution. If discharge is abundant, the use of bismuth, salol, or iodoform is indicated.

Antisepsis of the vagina is usually easy. Soap solution is used for cleansing the mucous membrane, which is afterwards irrigated with 4 per cent. boric, 2 per cent. protargol, or 1 in 2000 sublimate solution. These irrigations are repeated on several successive days. Instead of syringes, irrigators consisting of a glass reservoir and an india-rubber tube can be used. It is difficult, however, to disinfect the vagina when the mucous membrane is the seat of polypi, ulcerating tumours, or when it has been infected during removal of a putrid fœtus.

The uterus, after preliminary dilatation of the cervix, can be disinfected in the same way as the vagina, a long india-rubber tube being employed.

Beyond passing the catheter, operations on the bladder are seldom required. Before operating for calculus in horse or dog, a course of urinary disinfectants should be prescribed (salol, benzoic acid). In this case preventive treatment is of the greatest importance. Until now the dangers of catheterisation, as usually practised, have not received sufficient attention. Acute cystitis and its various complications may follow the introduction of soiled catheters, which are cleansed with difficulty and are more or less septic. Catheters and bougies should be disinfected by prolonged immersion in strong antiseptic solution, and afterwards enclosed in gauze and kept in a special case.

In operations on the foot, local antisepsis is ensured by the following method:—The shoe is removed, the plantar surface of the hoof thinned, the hair clipped away from the limb up to the knee, the hoof thoroughly brushed with hot water and soap, freely washed with an antiseptic solution, in which it should be immersed for a quarter of an hour to twenty minutes, then enveloped in compresses saturated with an antiseptic, and fixed in position by means of bandages. Linseed poultices prepared with a strong disinfectant solution certainly soften the horn, and may be useful,



FIG. 88.—Drainage tubes in sublimate or carbolic solution.

but from the point of view of antiseptis the superiority of compresses cannot be gainsaid.

In all operations to obtain primary union, the wound must be scrupulously guarded against infection. All bleeding must be stopped, and the tissues brought exactly into apposition. A thin layer of blood in an aseptic condition between the lips of the wound does not prevent primary union; the tissues tolerate it, and it is even serviceable in the process of repair; but large clots are harmful and present a very favourable soil for the growth of pathogenic microbes. The bleeding surfaces are dried as far as possible, covered with antiseptic vaseline [vaseline 50, powdered boric acid 5, iodoform 1], closely approximated throughout their extent, *i.e.* both superficially and deeply, and every effort made to secure contact. When coaptation is not perfect in the depth of the wound, a space is left for the accumulation of blood and serosity, in which any retained germs multiply rapidly. Where the wound implicates several different layers, it may be necessary, in order to keep these closely in apposition, to pass a number of deep sutures of catgut or silk fixed at their extremities to little rolls of gauze [deep or anti-tension sutures], in addition to inserting superficial sutures of silk or silk-worm gut. Lastly, the surface is washed with sublimate solution, dried with tampons of absorbent wool, and covered with a film of iodoform collodion, or with a dressing of surgical wool.



FIG. 89.—Irrigator for hospital use; for hanging on wall.

When it is impossible to bring the surfaces of the wound perfectly together, or when there has been much loss of substance, provision must be made to prevent the accumulation of discharges by inserting one or more rubber drainage-tubes, a strand of plaited catgut ligatures, or a strip of gauze. Rubber drainage-tubes are generally employed. They should reach the depth of the wound, and as they tend to spring out, they should be fixed to the lips of the wound by a silk or other suture. Their presence allows antiseptic injections to be made into the bottom of the wound without touching the sutures. When the wound is redressed the tube must be

removed, disinfected, shortened if necessary, and replaced. Its outlet should be level with the wound edges and not compressed in any way.

The seat of operation is protected by a "dressing" formed of layers of surgical wadding or tow, suitably arranged and fixed in position by bandages (*see* "Bandaging and Dressing"). Dressings applied to the upper regions of a limb should either be comparatively loose or should extend to all the parts below, in order to avoid interference with circulation and such consequences as swelling and sloughing.

The first dressing is exceedingly important. Very often it determines the entire after-course of the wound. It can be left in place for a varying time. If the patient's general condition is good, and the fever is slight, and if the dressing remains dry, it need not be renewed for twelve to fifteen days in winter, and from eight to ten days in summer. If, during removal, the deep layers of wadding adhere to the skin, they should be moistened and softened with a warm antiseptic solution, or in the case of the foot by placing the extremity in a bucket containing the liquid. The skin should be carefully cleansed with tampons of cotton wool.

Where primary union has occurred the wound is found cicatrised on removal of the first dressing: if, however, it is only progressing favourably, nothing more is needed than the application of a fresh dressing, the same precautions being observed as on the first occasion. Care must be taken to avoid disturbing the wound or moving the lips; drainage-tubes can be replaced after disinfection, fresh ones of similar calibre but of shorter length can be substituted, or drainage-tubes may altogether be discontinued. When the wound is suppurating the sutures must be cut, the drainage-tubes removed, and the whole cavity freely washed out, avoiding injury to granu-

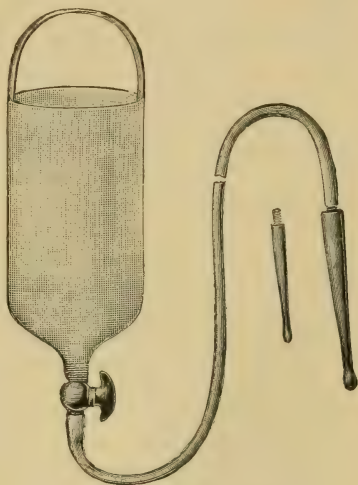


FIG. 90.—Portable irrigator.

lating surfaces. A new dressing, with or without drainage, may be applied, or the wound may be left open and treated with antiseptic liquids or powders. The latter absorb wound discharges, check the growth of germs on the surface, and diminish the absorption of toxic products.

The above are the measures required absolutely to prevent infection of operative wounds. Minutiæ and superfluous details have been omitted.

The Veterinary Schools of Europe contain operating theatres provided with installations and appliances for facilitating the practice of aseptic and antiseptic surgery. But it is not indispensable rigorously to follow in every case the technique, which has been indicated, to obtain good results. Without a large array of instruments, vessels, antiseptics, and dressing materials, asepsis in many operations can be nearly assured. Degive, who performed a series of one hundred castrations of cryptorchids without a single casualty, certainly did not conform in every respect to the rules of asepsis. Moreover many operations must be performed on the spot, and with the means at hand, if the patient is to be saved.

The treatment of incised, lacerated, punctured, and other accidental wounds is very similar to that required for operation wounds. Some wounds, particularly those of the upper parts of the limbs where bandages cannot be secured in position, may be treated by the open method and frequently dressed with antiseptic lotions or powders. Arterial bleeding usually demands immediate attention, and it should be arrested without delay. In some penetrating wounds the injured artery may be difficult to find, and in that event the wound may be stuffed with a styptic tampon of gauze or cotton wool and sutured. To remove foreign bodies and infective materials, and to promote early healing, accidental wounds must be thoroughly cleansed and disinfected. Where infection is feared or in doubt the wound should be swabbed or scrubbed and afterwards flushed with a warm solution of hydrogen peroxide, or tincture of iodine. Before closing the wound the necessity of providing drainage should be considered. Many accidental wounds are so situated as to drain naturally, provided a small opening is left at the most dependent point. Efficient drainage is most important in the treatment of punctured wounds, which frequently are infected by the wounding instrument. In many cases a counter-opening will be found to furnish the best outlet for discharge ; or the puncture may be enlarged, its track carefully disinfected, a drain inserted, and the whole wound covered with an absorbent dressing. In all accidental

wounds movement of the injured part should be prevented as far as possible by splints and supporting bandages, and, in horses, by slinging.

In routine practice, preference should be given to such methods of treatment as are simple, effective, and relatively cheap, but expense should be regarded as of secondary importance when dealing with penetrating wounds of the thorax, abdomen, joints, tendon sheaths, and with injuries to tendons, ligaments, and bones. It then becomes the duty of the practitioner to prevent, by every means in his power, the grave infectious complications which frequently result from such wounds. The unfavourable conditions under which he habitually works, render primary union of wounds in the greater number of cases uncertain. But, when unable to satisfy all the demands of the antiseptic system, he should at least observe its broad principles.

V.—DIVISION OF TISSUES.

Cutting and Puncturing Instruments. The first method of dividing soft tissues is by means of cutting instruments, as knives or scissors.

Knives are of varying form and size: those in which the blade and handle are immovable are termed scalpels; those in which the blade is protected with scales and turns on a hinge, bistouries.

Knives, again, may be divided into sharp-pointed and guarded or probe-pointed; either of these may be straight, convex, or concave.

Scissors are either sharp or round-pointed, and flat or curved in the blades (*see* Figs. 74, 75 and 76).

In making primary incisions a knife with a convex cutting edge is usually employed, and is grasped after the manner of a table knife (Fig. 91). In making long incisions the knife is held like a violin bow (Figs. 92, 93). For finer dissection the knife is employed after the manner of a pen (Fig. 94).

In dividing tissues from within outwards the knife is grasped in a similar way, but the cutting edge is now directed upwards (Figs. 95, 96, and 97). Incisions are made by a light, drawing movement of the whole hand, usually from left to right, seldom in the opposite direction.

The parts to be divided should be rendered tense by placing the thumb of the left hand on one side and the index finger on the other side of the line of incision, and employing gentle traction (Fig. 98).

When important vessels lie immediately beneath the point of incision it is sometimes convenient to raise the skin in a fold (Fig. 100).

When considerable force is required in making an incision the thumb



FIG. 91.



FIG. 92.



FIG. 93.

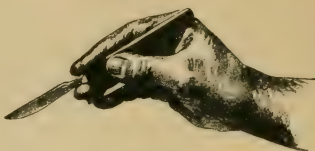


FIG. 94.

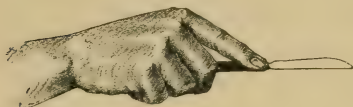


FIG. 95.



FIG. 96.

may be firmly applied to the skin, and the knife guided by the other fingers (Fig. 105): this prevents deviation from the straight line.

In dividing very hard tissues, like horn and cartilage, the knife is grasped with the whole hand (Fig. 106).



FIG. 97.

Incisions should be made rapidly and, if possible, of the predetermined length at one stroke. Too short an incision impedes the

deeper stages of the dissection, and is no advantage, for the linear cicatrix which may remain is of even less importance in animals



FIG. 98.

than in man. Moreover, the irregularity of the incision produced by a series of cuts greatly militates against rapid healing.

Scissors are held as shown in Fig. 107, the thumb and third finger in the rings, the index finger on the joint.

In dividing soft tissues the knife is either guided by a director or by the finger (Figs. 108 and 109). In the former case the director,

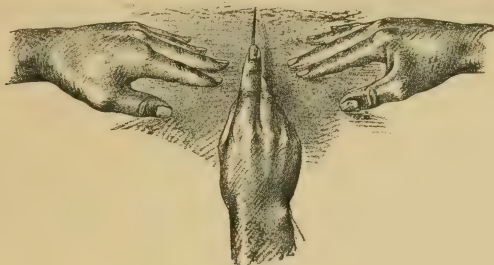


FIG. 99.

lightly held between the thumb and index finger, is introduced into an already existing opening in the tissues, a convex or pointed knife is slipped into the channel and steadily thrust forward with a lifting movement, so that at the end of the stroke it is nearly at right angles to the long axis of the director. In some cases it may be necessary to make the stroke towards the operator (Fig. 110).

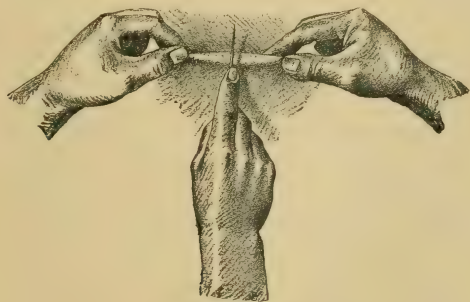


FIG. 100.

Where important organs might be endangered the operator grasps with forceps and raises a portion of the tissue to be divided, the neighbouring portion being similarly raised by an assistant, and the parts divided between the two forceps. The forceps are then reapplied and the dissection so continued.

For holding the edges of wounds apart sharp hooks or retractors are employed (Figs. 77 to 79).

When operating in certain cases other methods of dividing tissues are sometimes resorted to, such as tearing, blunt dissection, linear crushing by the *écraseur*, the use of the elastic ligature, and the cautery.

Tearing is chiefly used in removing sharply defined tumours which are only slightly adherent to neighbouring tissues. The skin having been incised the growth is isolated by pushing aside or tearing through the surrounding tissues with the fingers, or by a combination of these methods. Although valuable on account of not endangering important vessels or nerve trunks, this method gives very acute pain where the parts are richly supplied with nerves, and is inapplicable to such new growths as spread by the lymphatics, inasmuch as extirpation is incomplete and secondary tumours soon grow.

When larger tracts of tissue are in question the fingers of both hands may be employed. Although wounds so made are really torn wounds, they bleed relatively little, and often heal very rapidly.



FIG. 101.—Director.

For blunt dissection the end of a director or a small spatula may be used. The movement is of a stabbing or thrusting character, the point tearing through the connective tissue and isolating the part without danger of hæmorrhage. This method is excellent when operating in dangerous regions. It is particularly useful for isolating vessels, as in ligaturing the jugular vein or carotid artery. The wounds produced by blunt dissection heal almost as quickly as those made with the knife.

The *Ecraseur*. The *écraseur* (Figs. 102 to 104), is still much employed in veterinary practice. It crushes soft tissues, though to some extent it also acts like a saw. Mucous membranes, connective and fibrous tissues, muscles, vessels, neoplasms, are all cut without hæmorrhage if the instrument is worked sufficiently slowly. Its action is especially remarkable in vessels: the middle and internal coats rupture and retract whilst the external coat is stretched and twisted in such a way as to effect almost complete closure. Pain, which is very severe as compression begins, diminishes with commencing section. As a rule the surface of section cicatrises less

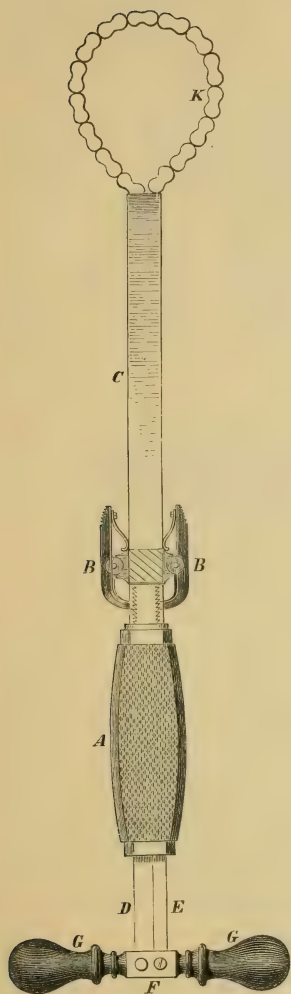
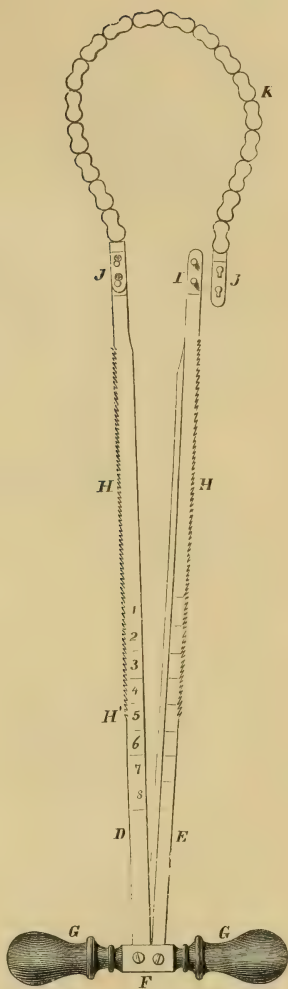


FIG. 102.—Chassaignac's écraseur.

FIG. 103.—Chassaignac's écraseur
dismounted, showing
rack.

rapidly than that made by the knife, owing to superficial cell necrosis. The écraseur consists of an articulated steel chain, the loop of which is passed around the part to be divided and drawn tight until the tissue is finally crushed through. Chassaignac's écraseur (Figs. 102 and 103) acts by means of the two rods $H H'$, which are provided with teeth controlled by the two spring pawls $B B$. By slightly depressing the handle $G G$ on either side, one of these rods is drawn forward a tooth and immediately secured by its corresponding pawl, when it becomes the fixed point through the medium of which the opposite rod is drawn downwards. The lower ends of the two rods thus act alternately as fixed points on which the handle $G G$ swings. Reference to the figures will show that movement of this handle in the method described will cause the rods gradually to descend, drawing the loop of the écraseur K within the tube C , and slowly dividing any tissue enclosed within the loop K . In later écraseurs, such as Fig. 104 the movement is effected

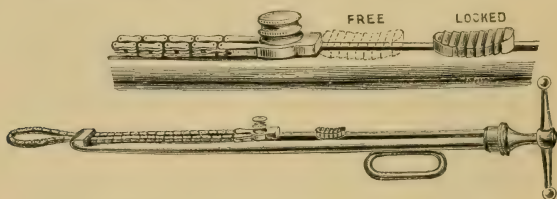


FIG. 104.—Professor Dewar's écraseur.

by a screw. At Professor Dewar's request Messrs. Arnold have produced an écraseur with a particularly neat and effective catch by means of which the screw can be thrown into and out of action very readily. When the catch is in the position marked "free" the "slack" of the chain can be taken up so that the instrument is ready to commence cutting as soon as put in operation. By slipping back the catch the chain becomes locked to the screw, and the apparatus is ready for use. The screw movement is certainly preferable to the rack originally fitted in the Chassaignac instrument. This instrument is now made long enough for the castration of mares and cows, and as the chain is bevelled on one edge it crushes through instead of cutting the tissues, thus avoiding a frequent cause of post-operative hæmorrhage. On the other hand it may be reversed if very fibrous tissues require to be divided.

Small and even medium-sized vessels may be divided in this way without bleeding. The action depends to some extent on the rapidity

with which the process is carried out. The slower the movement the less the bleeding. For this reason very vascular tissues should be very slowly divided, and pauses should occasionally be made ;



FIG. 105.



FIG. 106.

between each complete movement of the handles, or each rotation of the screw, fifteen to thirty seconds may be allowed to elapse.



FIG. 107.

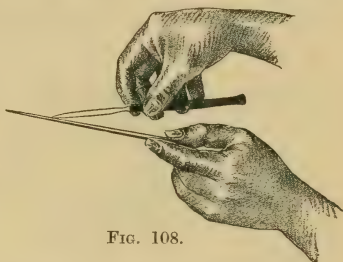


FIG. 108.

Specially thick tissues may be divided in two portions, the centre being perforated, and the chain applied alternately to either side.

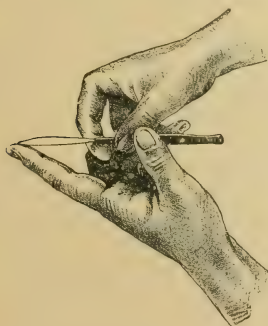


FIG. 109.



FIG. 110.

Ligatures. Soft tissues may be divided by passing around them a thin tightly-stretched cord. Linear necrosis continues at the point

of ligation until the cord becomes slack, but inasmuch as many materials like reindeer sinew or metallic ligatures are comparatively inelastic, the ligature may after a time require to be reapplied, and large masses cannot be dealt with by a single ligature, but require several.

The Elastic Ligature is exceedingly useful. Being applied in a tensely stretched condition it "follows up" the parts as they yield. Vulcanised rubber cord or tubing, of a thickness proportionate to the mass to be divided, is used. An assistant holds one end of the cord while the operator grasps and stretches the other, passing it three or four times around the pedicle of the growth. The two ends are held in a crossed position by an assistant, when they can be tied together with an ordinary thread.

After being firmly tied the ends are released, and as they immediately return to their previous volume they so greatly exceed the

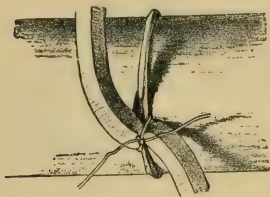


FIG. 111.—Diagram showing elastic ligature applied.



FIG. 112.—Diagram to show extent to which contraction proceeds.

area of the knot as to render impossible any chance of retraction. Fig. 111 shows a ligature applied to a rod, and Fig. 112, the same ligature removed, to exhibit the degree to which it finally contracts. Solid rubber cords are better than rubber tubes, which are apt to break when tied.

In removing tumours with well-defined pedicles the elastic band is easily applied, but when the tumour is more or less sessile it is necessary to transfix it with one or two long needles crossed at right angles to prevent the ligature slipping off.

The surfaces left by the elastic ligature granulate readily. This method is especially useful in ligaturing very vascular tissues because vessels are securely closed before division occurs.

Cagny recommended the elastic ligature for docking. The most painful part of this operation is not the division of the tissues, but their cauterisation, and in certain high-bred animals the application

of the iron causes violent struggling. Cauterisation can be dispensed with by applying before section an elastic bandage to the tail just above the point of division. It has been suggested that the bandage should be left in position for a week, but this would be dangerous, and it is sufficient to leave it twelve to twenty-four hours.

The Galvanic and Thermo-cauteries. In the galvanic cautery a loop of platinum wire is passed around the tissue to be divided, and after being raised to a bright red heat by the passage of an electric current, is gradually drawn tight. On account of its complexity and expense, however, this instrument is very seldom used in veterinary surgery, especially as Paquelin's thermo-cautery (Figs. 113, 114) renders almost equally good service and is much cheaper. The thermo-cautery consists of a hollow platinum terminal which may be of varying shape. After being heated in a spirit flame it is kept at a bright red heat by injecting a mixture of ether or benzine vapour and air into the head. Tissues divided by this instrument bleed very little, though the scab produced by the cautery must have a certain thickness, to attain which the division must be made deliberately. The wounds produced heal comparatively slowly. (For other cauteries, see pp. 155-160).

Puncture. A puncture is an incision of considerable depth but of comparatively small diameter. Puncture to permit fluids or gases to escape from cavities, like the thorax, abdomen, or bowel, is termed paracentesis. To prevent the entrance of air into deeper seated tissues or into the cavity to be opened, the skin is often drawn to one side before operation, so that returning afterwards to its ordinary position it closes the deeper opening. Subcutaneous puncture may also be practised by first introducing the perforating instrument horizontally a short distance under the skin, and, after altering its direction, making the desired puncture; the walls of the opening immediately collapse on the removal of the instrument.

An ordinary pointed knife, bistoury, scalpel or lancet may be used for puncturing. The knife is held like a pen, the thumb on one, the index and middle finger on the other side, the little finger being used as a support. The point is caused to enter vertically by extending the previously bent fingers. In withdrawing the instrument the opening may, if necessary, be enlarged (Figs. 120, 121). In using a bistoury or lancet the handle is held at right angles to the blade. Many persons grasp the blade, only leaving uncovered sufficient to penetrate to the desired depth; but this method, however, has the disadvantage that in case of a mistake in regard to the thickness of the tissues to be divided the fingers must be moved,

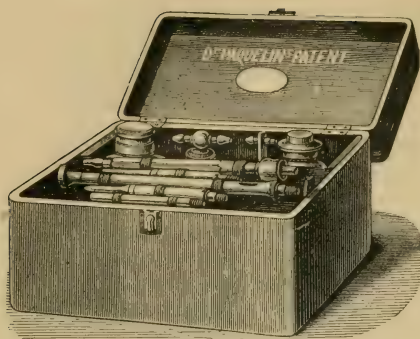


FIG. 113.—Paquelin's cautery in box.

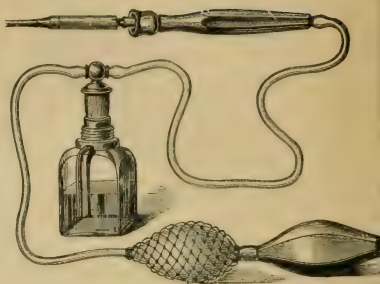


FIG. 114.—Paquelin's cautery in action.

FIG. 115.

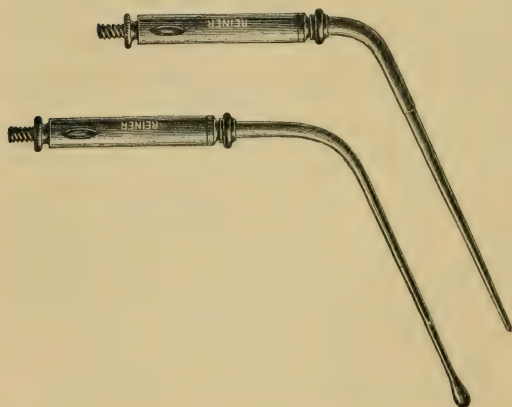


FIG. 116.

FIG. 117.



FIG. 118.



FIG. 119.



FIGS. 115-119.—Platinum heads for Paquelin's cautery.

moreover the operator runs considerable risk of wounding himself. The surgeon should possess sufficient delicacy of touch to know when opposition ceases, that is when the cavity is entered. Supporting the instrument with the fingers in the method described assists in this respect.

Other puncturing instruments are exploring needles and trocars.

The trocar consists of a pointed steel rod provided with a metal shield or tube, exactly corresponding with it in other respects but a trifle shorter. The rod may be of varying length and thickness, straight or curved, cylindrical or oval. The point is usually triangular in section. At the lower end of the cannula, where it abuts on the handle, are two holes or rings to permit of its being fixed into position by tapes. As a rule the upper end of the cannula discloses two short slits, which permit the parts to spring slightly

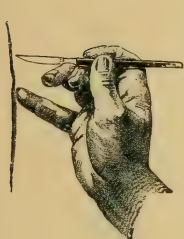


FIG. 120.

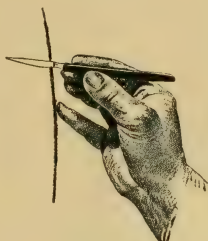


FIG. 121.

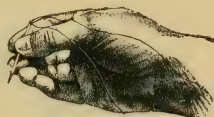


FIG. 122.

and apply themselves closely to a trifling circular depression formed just behind the point of the trocar. This device causes the instrument to enter much more easily, as the union of the trocar and the cannula then presents no projection. The handle of the trocar is grasped in the hollow of the hand, the fingers and thumb steady the stem, and in use the instrument is thrust into the cavity to be penetrated with a single rapid movement. The cannula is then fixed with the left hand and the stilette or trocar removed with the right. While withdrawing the cannula the trocar should be reinserted, and the skin in the neighbourhood of the puncture should be pressed down with the thumb and index finger of the left hand to prevent it being lifted.

Division of Hard Tissues. The horn of the hoof is divided with a special knife grasped with the whole hand, Fig. 106. Bones are divided with drills, chisels, saws, and forceps. The bone is prepared

for sawing by removing the periosteum with a periosteotome, or a chisel or gouge, Figs. 126-7. Files and rasps are sometimes used to remove sharp edges or projecting points from sawn surfaces. In this connection, the sharp spoon or curette, Figs. 128-130, used for scraping diseased bones and cartilages, unhealthy granulations, callous walls of sinuses, etc., deserves mention. It is not sufficiently valued in veterinary surgery. It consists, as the name indicates, of a small steel spoon with a sharp edge attached to a stem or handle. The

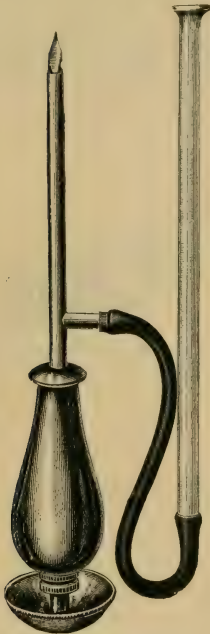


FIG. 123.—Trocar for tapping the chest.

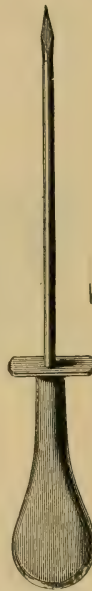


FIG. 124.—Trocar for tapping bowel.



FIG. 125.—Trocar for puncture of rumen.

most useful are the smaller because they can readily be passed into sinuses, in certain cases into bones, and into any hollow space. A selection of various sizes ought, however, to be kept. Curettes are sometimes formed with hollow handles, and an arrangement by which a stream of disinfecting fluid can be caused to flow from the bottom of the spoon, Fig. 130; the material loosened is washed

away by the stream of fluid. The curette is firmly grasped and used with considerable pressure. The sharp edge of the spoon quickly removes necrotic tissue whilst gliding over firmer healthy parts without seriously affecting them. Particular care must be taken to remove everything of a diseased nature, without which rapid healing need not be expected.

The chisel and gouge, Figs. 126 and 127, are now seldom employed for dividing bones because of the danger of shattering the bone when using the mallet or hammer. They have largely been replaced by bone forceps, Fig. 131, which are made with blades either at right angles to the long axis of the forceps or parallel with it. Each form has special uses.

Saws are of several forms. The frame saw (Fig. 132) consists of a blade, a frame, and a handle. The blade is made somewhat finer towards the back, so as to saw freely and not become fixed in the furrow. It is secured at one end by a screw for regulating the tension, and at the other carries a small rivet which prevents the blade slipping through the slot into which it is introduced. The frame is either quadrangular or semicircular. The handle was formerly provided with depressions to fit the fingers. As, however, this rendered it difficult to clean, modern saws are provided with plain curved handles.

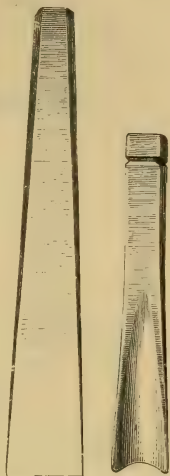


FIG. 126. FIG. 127.



FIG. 128.—Curette.



FIG. 129.—Curette.



FIG. 130.—Flushing Curette.

The nature of chain saws is almost sufficiently indicated by their name. They consist of a number of articulated links, carrying on one side saw teeth (Fig. 133). On account of their cost, however, they are not much used in veterinary surgery. The end of the chain

is passed around the bone by means of the needle and thread shown, and is then attached to the handle; by drawing the chain to and



FIG. 131.—Bone forceps.

fro the bone is gradually sawn through. A trephine (Fig. 309) consists of a hollow steel cylinder bearing teeth on its free border.

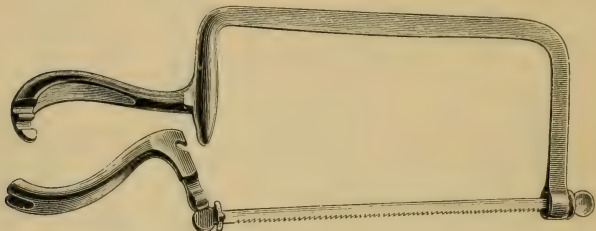


FIG. 132.—Frame saw for bone.

A central terminal steel point is usually added to steady the trephine in position, and by rotating the handle alternately towards the

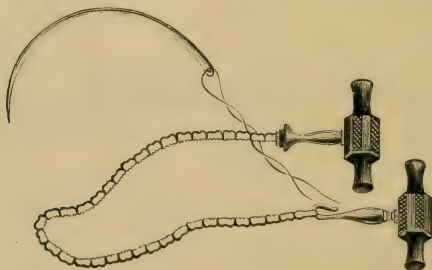


FIG. 133.—Chain saw.

right and left a circular piece of bone is gradually cut through. Trephines are used for opening the facial sinuses, the wall of the hoof, and the cranial roof.

VI—METHODS OF UNITING WOUNDS.

FIVE methods of wound healing are recognised, viz : (1) immediate union or primary adhesion ; (2) first intention or plastic adhesion ; (3) second intention or granulation ; (4) third intention or union of two opposed granulating surfaces ; (5) healing under a scab. Healing by primary adhesion seldom occurs except in small aseptic operation wounds. Healing by first intention or by adhesive inflammation occurs in aseptic incised wounds in which the edges have been maintained in apposition and free from irritation. Lacerated, contused, punctured and open wounds heal by second intention, but owing to infection, the process is usually accompanied by pus formation. In healing under a scab, the protective may be formed of dried blood or exudate, or furnished by antiseptic adhesives (collodion, tannoform, iodoform and tannin), or by the carbonised tissues as in using the actual cautery after amputation of the horse's tail.

Healing by first intention with the formation of a mere linear cicatrix is the surgeon's ideal, but can only be attained when the margins of the wound are accurately united and held steadily in position. Given these conditions, healing by plastic adhesion is assured in an aseptic wound. Apposition is best effected by sutures, *i.e.* by drawing together the edges of the wounds by stitches ; though some wounds may be united by the use of adhesives like collodion, wound gelatine (either alone or with the addition of oxide of zinc), sticking-plaster, pitch plaster, or strips of fabric fastened to neighbouring parts by glue.

The wound is disinfected, the hair shaved from the neighbouring parts, the skin dried, and slender strips of plaster applied at right angles to the long axis of the wound. Once these firmly adhere, the edges of the wound are pressed firmly together, the free ends of the strips of plaster carried straight across with some tension, and fastened on the opposite side. Another method is to fix strips on either side alternately, and by drawing in opposite directions on opposing pairs to bring together the lips of the wound. A third method consists in fixing a somewhat broad strip of plaster along each edge of the wound and uniting the strips by sewing. Dégive uses rubber bands to draw together the strips in place of sewing.

In using collodion the edges of the wound are pressed together with the fingers, the collodion applied thickly, and the wound held until such time as the dressing has had time to dry. Strips of linen may also be saturated with collodion, and applied rapidly across the edges of the wound whilst the lips are pressed together.

In veterinary practice, this method of uniting wounds can only be used in rare instances, partly because of the presence of hair, partly because of the animal's resistance and the violent contraction of its muscles, especially of its panniculus muscle. If plaster is applied, even in broad strips, over the hair it soon loses its hold, and the wound gapes or the continuous pull tears out the hair with a similar result. When the hair is shaved and the strips applied

directly to the skin, they are apt to become detached by the rapidly growing new hair before firm union of the wound surfaces has taken place.

Bandages, however, can be employed with greater success. In many positions, for example in the extremities, union can be effected by using bandages without the help of sutures; but the method is never thoroughly reliable, for which reason bandages are best utilised to reinforce or assist sutures, to neutralise excessive tension and tearing out of the threads, or to check movement, and thus ensure the most favourable conditions for union.

Formerly little attention was given to the proper use of sutures, and it was thought that in animals wounds seldom healed by primary

intention, the reason being that operators took little pains to ensure antisepsis, and consequently the sutures rapidly tore out. Only fresh wounds were sutured, and old wounds were always "freshened" before being united. It is true that fresh wounds present the most favourable conditions for healing by first intention, but it is also possible to bring together granulating surfaces and effect healing. Furthermore, bruised or torn wounds were not sutured, though even



FIG. 134.—Largu's suture needle; metal handle for aseptic surgery.

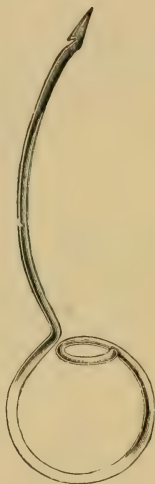


FIG. 135.
De Mooij's suture needle all metal, for aseptic surgery.

they may heal by primary intention, provided the margins are not absolutely crushed, have not lost their vitality, and have not been cut off from the circulation. Tissues in which the circulation has been reduced to an absolute minimum may still retain their vitality by means of the "plasmatic" infiltration until circulation of blood by the formation of new blood-vessels becomes possible, and small fragments of dead tissue can be cast off without imperilling primary union.

Deep wounds are often left open because of the danger of infection from retained discharges. By using drainage-tubes, however, some of these may be united without bad consequences. On the other hand, great

tension, especially in wounds with loss of substance, contra-indicates the use of sutures, which would rapidly cut out, and would therefore only be a drawback. Moreover, those portions of the lips of the wounds enclosed within the threads might themselves die, increasing the loss of substance.

Lacerated wounds, especially when deep or very irregular, are sometimes left unsutured, but when muscles have been torn and the margins of the wound are not puckered or necrosed sutures should be inserted. In such wounds the sutures may not remain in position for more than a few days, but they serve to promote union in a regular manner.

It is inadvisable to remove irregular fragments from the edges of a lacerated wound, because although the pared lips may more closely approximate to a straight line, sound tissue may be removed, the wound is enlarged, and the tension on the sutures must be increased.

Sutures are therefore only contra-indicated when marked tension exists, or when the wound suppurates or is offensive. Almost all



FIG. 136.—Needle-holder (Reiner's).



FIG. 137.—Showing method of using needle-holder.



FIG. 138.—Needle-holder (Hagedorn's).

wounds in animals are more or less infected, but by the free use of disinfectants such infection may be reduced to a minimum.

For suturing wounds needles and various kinds of suture material are required. Needles are either simple or provided with a handle, and may be straight or curved; some of the latter again being curved throughout, and representing the segment of a circle or ellipse, others half curved, only the anterior half being curved, the posterior being straight. The last two are the most useful. Some needles are curved

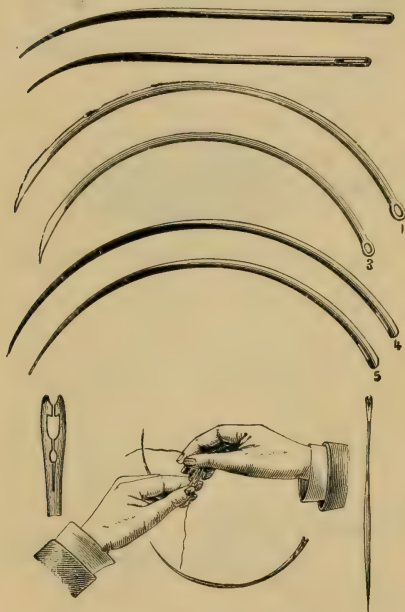


FIG. 139.—Suture needles.

in the plane of their greatest thickness in order to ensure greater stiffness. They are, however, less easily grasped and directed. In modern needles the point is almost always lancet-shaped and double cutting. Numerous complicated arrangements have been introduced to facilitate threading, but have not met with general acceptance. One of the most practical is shown in Fig. 139. Compound or handle needles are fixed in a handle and carry the eye close behind the point (Fig. 134). They are passed through the edges of the tissue until the eye is exposed, and then threaded and withdrawn, bringing the thread with them. When using small

or sharply curved needles, working in the depths of a wound or suturing firm tissues, a needle-holder (Figs. 136 to 138) is almost indispensable. In case of need a dressing-forceps efficiently replaces the special needle-holder.

The chief suture materials are silk, silkworm gut, and catgut, none of which impedes healing. Catgut is very useful, as it becomes absorbed after a time, and therefore the stitches require no further attention; but sometimes this occurs very rapidly, with

the result of releasing still disunited portions of the wound and allowing the lips to open. To overcome this difficulty, chromicized catgut, which only softens very slowly, is employed, but silk is preferable for all skin wounds, and can even be used for abdominal operations, as if properly sterilised it does not irritate and becomes encysted or disappears. A number of different sizes must be provided of each of these materials. Silkworm gut is very smooth, non-absorbent, and non-irritant; it is largely employed for suturing skin wounds where immediate union is of much importance. Soft metallic wire, kangaroo tendon, and prepared horsehair are also used. To preserve silk and catgut in an aseptic condition the special holders shown in Figs. 84 and 85 are very practical.

General Directions for inserting Sutures. Before inserting sutures bleeding must have completely ceased. Capillary hæmorrhage is sometimes stopped by the sutures themselves, the bleeding surfaces being pressed together; but any large vessels should be ligatured or twisted, otherwise the object of suturing will be defeated. All foreign bodies, and not merely those of a macroscopic character like fragments of dirt from the wounding body, or of crushed tissues, clots of blood, etc., but also organisms which would set up inflammation and suppuration, must be removed. This can be effected by shaving the hair from around the wound and carefully disinfecting the parts. Wounds are in the most favourable condition for union when all bleeding has ceased and the surfaces are covered with a thin film of clear serum. Although in human surgery only sterilised, that is, aseptic, dressings and sterilised water are used, it is much better in animals to use some disinfectant, because in their case wounds are much oftener infected from the beginning, and have usually been inflicted a considerable time before coming under the surgeon's notice.

The preceding measures having been carried out, the lips of the wound are approximated, and a decision arrived at as to the number, kind, and arrangement of the sutures to be used. The number, of course, depends on the size of the wound, and the kind on the tissue to be united—whether it be skin, bowel, muscle, etc. In wounds of the external ear with division of the conchal cartilage, and wounds of the eyelid involving the tarsal plate, the divided cartilage should be separately sutured and not included in the cutaneous sutures. The first suture is best inserted where the parts are most out of line. In very long wounds a series may first be placed at somewhat long intervals, so as to ensure the approximately correct apposition of the edges before proceeding to final closure.

Sutures must be so inserted as to bring the lips of the wound into close contact at all points, and it is better to err on the side of using too many than too few. In mucous membranes, bowel, etc., more sutures are necessary than in the case, say, of skin. Their distance apart ranges between three sixteenths and three eighths of an inch. The points of entrance and exit should be at equal distances from the borders of the wound, and in the case of the skin not less than three eighths of an inch. The old rule, however, that the needle should be inserted at a distance from the edge equal to the depth of the wound, so that the surfaces should touch throughout their extent and no open space remain below the suture, is not always to be followed; one is sometimes obliged to seek primary union of the skin, leaving union of the depths to follow by granulation. A drainage-tube may then be inserted to facilitate discharge, care being taken to select the most dependent point for its exit; but considerable doubt has been thrown on the efficacy of drainage-tubes, and after being replaced by gauze, plaited horsehair, etc., they have been finally abandoned by a good many operators. They are, however, useful in properly selected cases. Retention of discharge must be carefully prevented, because not only would such discharge prevent immediate contact of the deeper surfaces of the wound, but it would greatly favour the multiplication of micro-organisms.

When rapid healing of deep wounds is of great importance, the deeper seated structures should be united with aseptic material, and the threads cut short before the skin wound is closed. These "buried sutures," if aseptic, cause neither irritation nor suppuration. In penetrating wounds involving the peritoneum the serous surfaces must first be brought together, then the muscles, and finally the skin; similarly in extensive wounds of tendon sheaths and joints, the tendon sheath or capsule of the joint is first to be united and afterwards the skin.

To avoid displacing the margins sutures should be inserted at right angles to the long axis of the wound. They should merely bring the surfaces into contact and hold them together; the most frequent error in this respect is to draw them too tight, causing them to cut out or even to produce local necrosis of the lips of the wound. They should be left in position until the new tissue has become sufficiently firm. Primary union occurs within three to five days or not at all; the changes in the wound after this time only influence the firmness of the cicatrix. The usual direction, to remove sutures between the fourth and sixth days, without reference to the size,

degree of tension, mobility, etc., of the wound, is apt to be followed by tearing apart of the newly formed, tender tissues within the succeeding twenty-four hours, necessitating a fresh operation. When sutures threaten to cut out, either from being drawn too tight or from local swelling, it is often advisable quickly to insert a few fresh ones rather more distant from the edges, so as to avoid the need for entirely resuturing the parts, which is not always successful. Sutures of aseptic material may be left in position eight to fourteen days or even longer without causing suppuration.

Sutures may be divided into uniting or coaptative, which serve to draw wounds together, and tension sutures or sutures of relaxation, which counteract the pull exercised by the tissues and thus relieve tension on the uniting sutures.

The greater number of special sutures described from time to time have only an historical interest.

Skin Sutures. The most important and the most commonly used is the plain interrupted suture shown in Fig. 140, which can be employed in almost all cases. It is made by passing a thread through the opposing lips of the wound, drawing the free ends together, and tying them firmly towards one side of the wound. The needle carrying the suture is grasped in the right hand, the thumb on the concave, the index and middle fingers on the convex side (Fig. 141), or a needle-holder may be used (Fig. 137). The edges of the wound are successively raised with forceps, and the needle passed through them first from without inwards, then through the opposite lip from within outwards (Fig. 141). Another method, however, is to raise both lips together, producing a somewhat deep fold, through the upper part of which the needle is passed with a single thrust (Fig. 142). This secures a larger surface for union; when only the extreme edges of the skin are brought into contact, rapid union is much less certain. The comparative poverty of blood-vessels in the skin of animals as compared with that of man explains the difficulty with which skin surfaces alone unite, or when united hold together under tension. The appearance of a wound sutured in the above-described manner is certainly somewhat unsatisfactory, but there need be no fear of the fold remaining. As soon as the threads are absorbed or removed the fold disappears, leaving only a narrow cicatrix. To relieve tension in wounds so united it is generally desirable to insert one or more "relaxation" sutures.

Sutures may be tied successively as inserted, or tying may be deferred until all are in place. In animals it is usually best to tie them as one proceeds. The fear of them tearing out when the

animal rises is unjustified, provided a sufficient number have been used and one or more "relaxation" or "tension" sutures have been inserted. Bayer always sutured wounds left after the removal of elbow tumours (capped elbow), and although the sutures were exposed to great strain on the animal rising he never saw them tear out. In this country, of course, such tumours are not infrequently

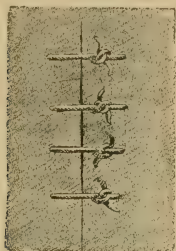


FIG. 140.—Interrupted suture.



FIG. 141.—Inserting the suture.

removed in the standing position under local anæsthesia, and the danger of tearing out is therefore comparatively trifling.

The knots should lie to one side of the line of union, not on the wound. The threads are cut off short. When the lips of the wound are thin they often tend to turn inwards when sutured and to delay union. This cannot take place where a fold is raised, but should it occur it can easily be rectified by raising the edges with dissecting forceps and holding them in this position until the sutures are tied.

In tying a surgical knot the free end of the thread is twisted *twice* around the fixed end when forming the first portion of the knot. To remove sutures the knots are grasped with forceps, the loops lifted sufficiently to allow the point of the scissors to be slipped gently beneath, and the threads cut and withdrawn. Should a thread stick, the lips of the wound may be supported with the free hand whilst the thread is being extracted.

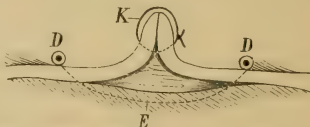


FIG. 142.—Methods of suturing to secure largest possible surface for adhesion. *K*. Interrupted suture. *D, D*. Suture of relaxation.

The continuous suture or glover's stitch (Fig. 143) is, after the interrupted (Fig. 140), probably that most commonly employed. It begins at one end of the wound like an ordinary interrupted suture. After tying the first suture the thread, however, is not cut off, but

is carried obliquely across the lips of the wound and reinserted on the opposite side, the needle being passed once more at right angles through the edges of the wound, which must be held in close apposition. In this way the thread passes continuously from one end of the wound to the other. At the point where it finally emerges it is cut off and tied at one side of the wound, so that the beginning and end resemble an ordinary interrupted suture. Another method consists in leaving the ends free until the suture is complete, when they can be knotted together, forming a long loop. In removing this suture the thread is divided at each loop, and the fragments withdrawn one by one. The glover's stitch has the advantage of being rapidly inserted, but many regard it with disfavour. Despite the greatest precautions the wound cannot always be maintained aseptic. If the glover's stitch has been used, and it should become necessary to relax or remove a thread here and there, the whole wound reopens.

In the blanket or button-hole stitch (another form of continuous suture) the needle, after traversing the lips of the wound, is carried under the slack of the thread, so that the loop of each stitch as it is tightened is maintained at right angles to the edge of the wound, whilst the intermediate portion lies parallel to it.

The pin suture, also known as the twisted or figure-of-8-suture (Fig. 144), though much praised by certain operators is less often used than formerly. It is employed where the edges of the skin are very thin and without much subcutaneous tissue, as, for example, in the eyelid, wing of the nostril, skin of the cheek, lip, etc., and where the margins show a tendency to roll inwards. The pin then acts as a support for the edges of the skin. The pins are usually from one and a half to two inches in length, and parallel sided. They should be flexible, and may be of brass, copper, silver, etc. Ordinary pins, however, are often used. They are sometimes inserted with a special instrument which holds the pin in a short tube provided with an awl-shaped handle; or with the aid of a pin director or grooved needle. The pin-director is passed through the edges of the wound, and the pin having been inserted in the groove near the point is brought into position by withdrawing the director. Pins are passed at some distance from the edges of the wound, and a thread wound around the free ends in a figure-of-8. Where several pins are inserted in series one thread may be used for securing the whole, as in Fig. 144; in other cases a separate thread is employed for each. When secured the points of the pins are removed with cutting pliers. In removing pin sutures the margins of the wound

should be pressed gently together with the fingers, when the threads can be cut and the pins removed. Threads glued to the skin by discharges may be left for a time in position.

Another form of suture comparatively little employed is the so-called shoemaker's stitch. It is used in removing hernial sacs, new growths, etc. An awl-like needle carrying a long thread is passed through the new growth, and the loop is cut, leaving the growth transfixed with two threads. By tightly tying together the free ends of these threads on opposite sides the circulation in the peripheral portion of the growth is stopped, causing the part to become necrotic and fall away. By using a series of such sutures large growths may effectually be removed.

Of tension sutures or sutures of relaxation there are several varieties. Ordinary interrupted sutures may be used for this purpose

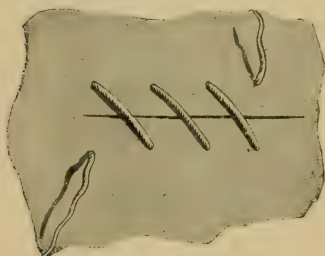


FIG. 143.—Continuous or glover's stitch.

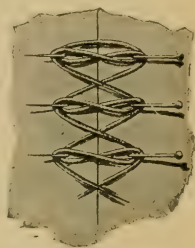


FIG. 144.—Figure-of-8 or pin suture.

if more widely spaced and inserted further from the edges of the wound and to a greater depth than usual (see Fig. 145).

To equalise and distribute pressure, thus preventing the stitches cutting through the skin, the suture shown in Fig. 146 is often used. It is formed by passing a number of double sutures through the lips of the wound in such a way that the loops lie on one side, the free ends on the other. A small cylinder of any kind, like a quill, or piece of cane, is then slipped through the loops; the free ends are drawn tight and tied over a similar cylinder applied on the opposite side. The cylinders extend for some distance beyond the ends of the wound.

It happens, however, at times that animals lie on the part so secured, and the cylinders are apt to cause pressure necrosis, making it necessary to remove the whole of the sutures despite their still being required. A modification was therefore introduced in which

small rolls of gauze or tufts of cotton wool are employed for each complete suture, allowing one to be removed without disturbing the rest (Fig. 147). As, however, these become hard when saturated with blood or discharge, they may advantageously be replaced with small pieces of disinfected rubber tube, which can easily be cleaned, and which yield slightly when swelling occurs. In long wounds comparatively thick drainage-tubes may be used, sufficiently long to extend beyond the ends of the wound, thus reproducing the old form of suture shown in Fig. 146. This secures the advantages of greater cleanliness and a certain yielding quality, which permits of the longitudinal tube adapting itself to irregularities of surface, and thus exercising more regular pressure. Should a suture threaten to cut, the drainage-tube may be divided at any point, and the compound suture converted into interrupted sutures.

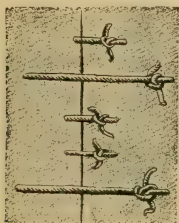


FIG. 145.—Ordinary deeply placed interrupted sutures used as sutures of relaxation.

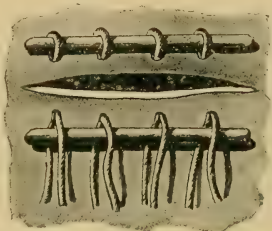


FIG. 146.—So-called "quilled" suture.

Another form of tension suture is shown in Fig. 148. The free ends of the silver wire are passed through small oval plates of any light metal like aluminium, and secured by perforated shot slipped over the wire and compressed by pliers. Occasionally the plates are omitted, and small leaden shot, buttons, or glass beads alone used. The suture is then secured by forming a rather large knot above the bead at each end.

Bowel Sutures. For uniting the walls of the bowel many complicated methods have been proposed, some of which certainly were of value in pre-aseptic days, but are now discarded. Possessing as we do suture materials which may safely be abandoned in the abdominal cavity without setting up suppuration, peritonitis, etc., many special precautions are now unnecessary. The sutures hereafter described are those most frequently employed and easiest to use. In devising a bowel suture, it must be borne in mind that mucous membrane will not readily unite with mucous membrane

on account of the continuous secretion, and that the parts to bring together are the muscular and serous coats, the latter of which shows a great readiness to adhere and unite. Sutures must also ensure perfect closure of the bowel wound and absolutely prevent bowel contents exuding. They should, therefore, be inserted about every one eighth of an inch. On account of the thinness of the walls slender needles are necessary. Special fine curved needles or fine sewing needles can be employed. Aseptic silk is probably the best sewing material; catgut is less adapted for the purpose, as it is sometimes too rapidly absorbed, the sutures yielding before the union of the surfaces has occurred. To prevent this, catgut rendered more resistant by the action of chromic acid has been introduced, but boiled silk has no such disadvantage and serves every purpose.

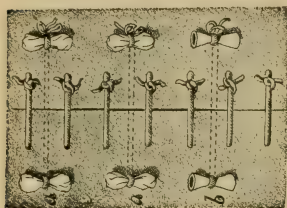


FIG. 147.—Interrupted sutures combined with sutures of relaxation.

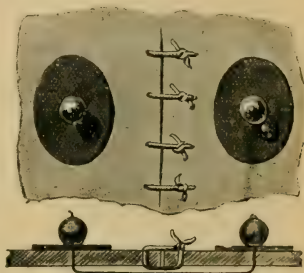


FIG. 148.—Tension suture in position.

The first and simplest form of suture was Jobert's. The needle was first passed through the serosa at some distance from the wound, penetrated the entire thickness of the bowel, and emerged close to the free border of the wound. The opposite lip of the wound was transfixed in a similar way. The ends were then knotted together and cut off (Fig. 149). This suture brought the serous coats into apposition, as shown in Fig. 150, but had the disadvantage that the threads passed through the lumen of the bowel, and might thus convey septic material from it into the peritoneal cavity, producing infection and inflammation in the track of the suture, resulting later in peritonitis.

For this reason Jobert's suture was discarded in favour of Lembert's, in which the threads are passed in a similar way but do not penetrate the mucous membrane, only extending to the muscular or submucous coat (Fig. 151).

Czerny reinforced Lembert's stitch by interrupted sutures uniting the mucous membrane, Lembert's stitch being employed to bring the serous surfaces into apposition; he thus unites the edges of the wounds twice. The first series do not penetrate deeper than the submucous tissue. This system, however, is difficult to carry out. It is much easier if the suture begins and ends in the serous coat; the knots then lie externally between the two surfaces of peritoneum.

In isolated instances it may be desirable to unite the mucous

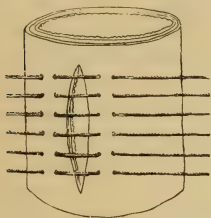


FIG. 149.—Schema of Jobert's suture (now abandoned).

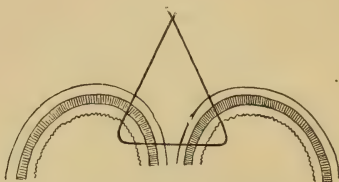


FIG. 150.—Schema showing Jobert's suture in section.

membrane itself. In such cases the first half or more of the incision should be sutured from within, and the knots tied on the inner surface. As, however, the wound becomes smaller this is no longer possible, and the remaining half of the wound must be united with sutures penetrating to the submucous coat but tied externally. The whole of the wound having thus been closed, the serous surfaces are brought

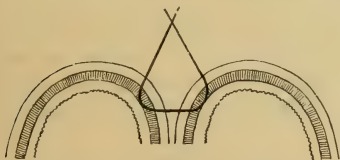


FIG. 151.—Lembert's bowel stitch.



FIG. 152.—Lembert-Czerny bowel stitch.

together in the manner above indicated. It might be advisable in cases where other tissues lined with mucous membrane are divided, as for instance the eyelids, cheeks, salivary or urinary ducts, the œsophagus or bladder, to proceed as above, uniting mucous membrane to mucous membrane. The apposition of secreting surfaces should, however, be avoided.

Artery sutures are very seldom required in veterinary practice, though small longitudinal wounds of arteries have been successfully

closed by inserting closely placed sutures of fine silk. In exceptional cases the continuity of a severed artery may be preserved by adopting Murphy's method of invaginating the central end within the peripheral end of the vessel and securing the parts with fine silk sutures.

Tendon Sutures. In man recently ruptured tendons are united by deep catgut or reindeer tendon ligatures left in position. In such case the cut ends are drawn together by three or four strong sutures passed through the substance of the tendon, and the divided sheath, if not too much lacerated, is closed by fine catgut sutures. The external wound is then dressed and bandaged in the usual way. In one method the needle is inserted about a quarter of an inch from the cut end of the tendon, carried (say) downwards beneath the superficial layers of tendon fibres, brought out through the torn surface, and passed through the opposite end of the tendon after a similar but reversed fashion. The ends are knotted and cut off. If necessary, a complete ring of sutures may thus be inserted around the tendon, after which the outer wound is closed. It is often extremely difficult to insert sutures because the muscles retract the ends of the tendons to a considerable distance. The divided ends may, however, often be gradually approximated by inserting sutures, applying a dressing, and fixing the limb as far as possible with splints and plaster bandages. In small animals union of a ruptured tendon may be readily effected by sutures and by securing the limb in a position which will prevent undue tension of the sutured tendon. In cases associated with loss of tendon substance or where the space between the ends is too large to permit of their immediate approximation, the gap is sometimes bridged by incising one end of the tendon to form a flap, which is attached to the other end by sutures. In horses and cattle ruptured flexor tendons are seldom sutured, but severed extensor tendons can be successfully treated by suturing and the application of splints or a plaster bandage to the limb.

Nerve Sutures. In suturing divided nerves fine sewing needles are required. The edges of the cut nerve sheath are brought together by a number of closely placed stitches, and one or two sutures may be passed through the nerve trunk. Immediate contact of the cut ends is desirable, though not always possible without traction on the nerve. But even where the ends, after suturing, are separated by a space of half an inch, repair will follow and there need be little fear of permanent loss of function. As suppuration is the chief cause of imperfect repair of wounded nerves aseptic precautions should be scrupulously observed throughout the operation.

VII.—METHODS OF PREVENTING OR CONTROLLING HÆMORRHAGE—HÆMOSTASIS.

THE first check to the flow of blood from a divided vessel results from the contraction of the internal and middle coats and the mechanical closure of the bleeding orifice. The flow being checked a clot soon forms, which seals the aperture, partly by its contraction, partly by acting as a plug or cap. The slower the flow the more quickly does such a clot form. The cardiac weakness following on loss of large quantities of blood therefore favours cessation of bleeding.

In incised wounds, the divided ends of the vessel retract into the tissue, which then closes over them and checks hæmorrhage. The outer coat of torn and crushed vessels often becomes twisted into a kind of cord, while the intima is induplicated after the fashion of a valve. Bleeding is therefore often slight even when very large vessels have been torn or crushed. A clot having once formed extends, as a rule, up to the next collateral branch of the injured vessel.

The exact nature of the changes by which a divided vessel is closed is not yet clear, and although we know that a thrombus forms, yet the reason of its formation is still disputed.

The thrombus either becomes replaced by connective tissue or it softens and breaks down. The former is the more favourable development, and consists in the gradual formation of connective tissue, which usually results from proliferation of the endothelial lining of the vessel. The endothelium is first converted into polymorphous "formative cells," which rapidly multiply, extend into the thrombus and replace it, leaving only a pigment residue (oxyhydrate of iron) of the original thrombus. From the vasa-vasorum new blood-vessels extend into the new tissue, converting it practically into connective tissue. The thrombus thus plays a passive part, being gradually replaced by fibrous connective tissue. These changes occur with comparative rapidity; vascular new tissue may be found at the point of ligation eight days after operation. Where, however, the intima is extensively diseased, or where general constitutional disturbance exists, the changes proceed more slowly.

Circulation is usually restored by collateral paths, the smaller vessels enlarging and conveying the blood by parallel channels. This change also is often very rapidly effected, as shown by Nothnagel's experiments on rabbits. Six days after ligation of an important vessel the muscular coats of the dilated collateral vessels were found

to be thickened. This result was formerly attributed to rise in blood-pressure, but was regarded by Nothnagel as due to more rapid movement of the blood in the vessels in question, and to the resulting increased nutritive supply.

Hæmostasis by a plug or thrombus is, however, only a provisional measure. Its purpose may be frustrated by suppuration occurring in the walls of the vessel and extending to the clot, which then breaks down; or increasing blood-pressure may drive out the plug, an accident most likely to occur where the vessel is injured close to a collateral branch. In such cases secondary hæmorrhage follows. Final closure of the vessel is only brought about by union of its walls, by new formation of connective tissue, and by cicatrisation of the tissues surrounding the vessel.

Hæmostatic agents are very numerous, but of very varying utility. Many have now been entirely discarded; they persisted from pre-antiseptic times, when ligation was only too frequently followed by suppuration with separation and discharge of the ligature. They may be divided into (1) thermic, (2) chemical, (3) and surgical.

Of thermic agents the most popular is cold; it is, however, only useful for checking bleeding from capillaries or comparatively insignificant vessels, and even then is uncertain. The result depends on reflex contraction of the walls of the vessel and surrounding tissues checking the flow of blood. When a strong stream of water is used contraction of the tissues is increased by the mechanical stimulus. Heat is usually applied by means of the cautery; the tissue, together with a portion of the escaping blood, is carbonised and forms a firmly adherent scab which closes the lumen of the vessel. This succeeds well in the case of small vessels, but is of comparatively little value in dealing with the larger. To check bleeding from already existing wounds the cautery should be of a bright red heat, because a firm scab is required, and one wishes to prevent the cautery adhering to the wound. When, however, it is used to make incisions the instrument should be red and should be moved slowly. Although the resulting scab is sterile, and if very small may even undergo absorption, it is impossible to effect primary union between wound surfaces so treated. For this reason the cautery as a hæmostatic instrument has largely been given up, though in castration it is still used to close the divided spermatic artery. It may be remarked in passing that bleeding from hollow organs like the uterus is often best controlled by irrigations with water at a temperature of 120° F.

Most styptics combine rapidly with the blood, and form with it a clot which adheres to the wound and closes the injured vessel.

Some act by causing contraction of the vessel and surrounding tissues. Among those formerly employed were oak bark powder, tannin, mineral acids and their salts, alum, nitrate of silver, acetic acid, creosote, carbolic acid, alcohol, oil of turpentine, etc. Perchloride of iron in the form of liq. ferri perchlor. diluted with three parts of water is often used to moisten tampons which are applied to the bleeding spot. The most popular and effective styptic is solution of adrenalin, which quickly arrests bleeding from capillaries and small vessels. To check bleeding resulting from internal injuries, and to lessen hæmorrhage during operations, calcium chloride, which increases the coagulability of the blood, gelatinised serum, extract of ergot, and hydrastis canadensis have been employed with success. In operation wounds powerful styptics sometimes retard or prevent healing by first intention, owing to their caustic or astringent effect on the wound surfaces.

Surgical methods of controlling or arresting hæmorrhage are represented by the tourniquet, Esmarch's bandage, and rubber cord, by compression, ligation, torsion, forcipressure, and acupressure. As a preventive, especially when operating on the limbs, the application of a tourniquet (Fig. 153), or a rubber cord is the means usually employed.

For the horse the most primitive method consists in passing a loop of cord or webbing around the limb and tightening it by the rotation of a stout stick slipped through it. The pressure thus exercised on the vessels checks circulation, and hæmorrhage during operation is virtually *nil*, while owing to compression of the nerves sensation below the ligature is dulled and the pain of operation greatly diminished.

A more refined method is to use a rubber cord or tube. A rubber cord half an inch thick and twenty to thirty inches in length is passed around the limb above the knee or hock in a stretched condition. The ends are united by a simple knot or a strong cord.

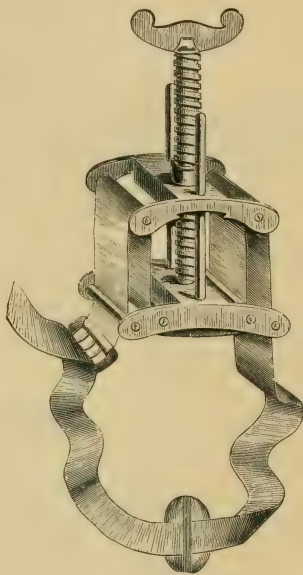


FIG. 153.—The tourniquet.

Esmarch's bandage is most valuable when, in amputating limbs in small animals or excising some very vascular organ like the uterus, one wishes to minimise bleeding. When properly applied it enables operations to be performed as though on the dead body; no bleeding occurs, and all parts, the normal as well as the pathologically altered, are distinctly visible. It is an elastic bandage, formed preferably of vulcanised rubber (though a fabric of rubber

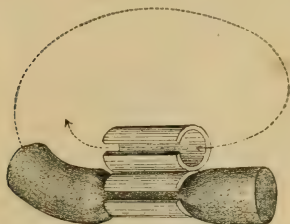


FIG. 154.—Catch for rubber cord used with Esmarch's bandage.

threads covered with cotton is sometimes used), applied to the limb or organ to be removed, commencing always at the periphery. The strong pressure exercised by the spirals of the bandage as they advance over the tissues gradually drives the contained blood towards the trunk. When the parts to be excised have thus been rendered bloodless a rubber cord is applied with considerable pressure immediately above the

bandage. This compresses the arteries and practically brings the local circulation to a standstill. The ends of the cord are secured by tying or preferably as shown in Fig. 154. The cord is stretched and slipped into the first of the incomplete cylinders; is then carried once or twice around the limb, stretched tightly to

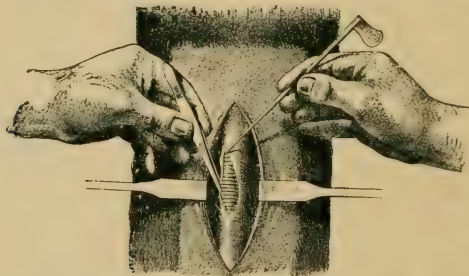


FIG. 155.—Ligating an artery; first stage.

allow it to be inserted in the second cylinder, and then sharply released. Its elasticity causes it to be firmly held in position within the cylinder. The bandage is then removed and the operation performed below the cord.

In veterinary practice Esmarch's method is not usually applied in its entirety, the operator often being satisfied with the application

of the cord. Generally, this modification is advisable when the tissues have undergone much change, and are infiltrated with infective fluids which might be pressed into the healthy tissues by the bandage and produce very grave results.

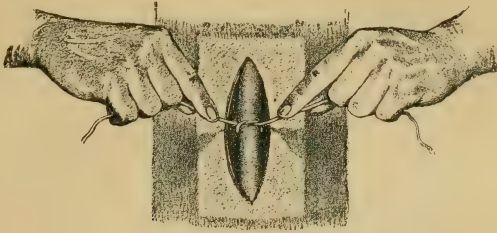


FIG. 156.—Ligating an artery; second stage.

Compression is useful where one cannot ligate the divided vessel. The portion of the wound where the divided vessel is seated is

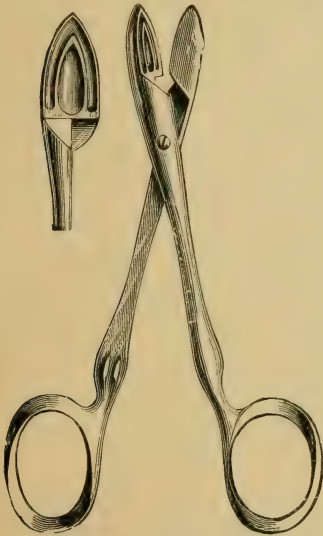


FIG. 157.—Greig-Smith's artery forceps.

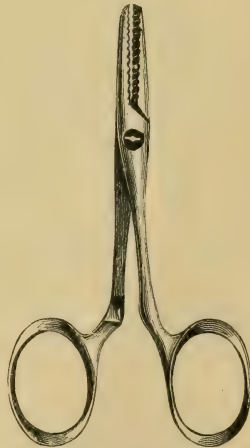


FIG. 158.—Spencer Wells' artery forceps (with separable limbs for cleaning).

compressed either with the finger or with a tampon of cotton wool (immediate compression). In the event of this failing, the main vessel supplying the parts is compressed at the point nearest the

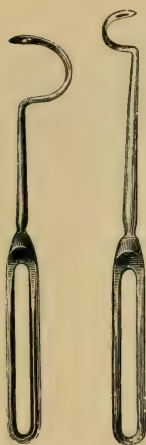
wound, where it can be brought directly against a bone (mediate compression). This plan rarely stops bleeding completely, however, and at the end of the operation one is obliged to resort to some other method. In dealing with hollow wounds long strips of anti-septic gauze, tarlatan, or muslin may be packed into the cavity under pressure, and the lips of the wound provisionally united by a few sutures. This usually checks bleeding from small vessels.

Ligation is effected with threads of silk or catgut: chromic gut is the best. When an artery crosses the field of operation, and must be divided, it is isolated, ligatured in two places, and the section made between the two ligatures. If a vessel, whether artery

or vein, is accidentally divided, the ends are grasped with forceps and strongly ligatured as high up as possible, using a surgical knot. In the case of an artery, the object is to divide the inner and middle coats, which retract, and become incurved towards the axis of the vessel, whilst the external stretches slightly, and its surfaces are brought into close apposition. When using catgut the ends of the knot may be cut short, but in the case of silk usually only one is cut short, the other being brought outside the wound unless asepsis be assured. It is withdrawn a day or two later, when the vessel has been cut through. Wells' or Greig-Smith's forceps, with large jaws of conical or cylindro-conical section, are very convenient when ligating vessels. The ligature, on being tightened, slips over the nose of the forceps, and surrounds the vessel. Immediate ligation is always to be preferred. Where it is impracticable, as when the ends of the vessels

have retracted deeply within the tissues and cannot be discovered, or when the tissues are very friable and break away as grasped, mediate ligation, or ligation in the continuity of the vessel, may be performed.

The instruments required are a scalpel, two retractors, dissecting forceps, a director, ligatures, and aneurysm needle (Figs. 159 and 160), *i.e.* a curved needle with fixed handle. The method is as follows:—The skin is incised directly over the artery, the lips of the wound are drawn apart with retractors, and dissection cautiously continued until the artery appears. A fold of the artery sheath is then lifted



FIGS. 159, 160.—
Aneurysm needles.

and divided, leaving the artery itself free. If preferred the artery sheath may be torn through, using two pairs of dissecting forceps. The artery is freed from its sheath for some distance as in Fig. 155 (which is semi-schematic). One margin of the sheath is lifted with forceps and drawn slightly away from the artery, around which the ligature is passed by means of an aneurysm needle. Care must be taken that only the artery, and not the accompanying vein or nerve, is included in the ligature. One end

of the ligature is held with the fingers or forceps and the needle drawn back, leaving the thread around the vessel. The knot is tied in the manner before indicated, and shown in the semi-schematic illustration, Fig. 156. The ends of the ligature are then cut off short, and the wound sutured and dressed.

After ligation the neighbouring parts are nourished by collateral anastomosing branches (Fig. 161). In injuries to large vessels, however, the existence of this collateral circulation is sometimes responsible for secondary bleeding from the peripheral ends should the vessel not have been ligatured both in front of and behind the injured spot. In former times it was considered dangerous to ligature veins.

Nowadays no distinction is made between veins and arteries. Large veins, however, should be doubly ligatured for similar reasons to those above stated, and also because in the case of large veins

air might possibly be aspirated through that portion of the vein nearest the heart with fatal consequences.

Torsion may replace ligation in dealing with small arteries and veins. The mouth of the bleeding vessel is seized with forceps, drawn slightly forward, and the forceps rotated five or six times (limited torsion). To make quite sure of closing the vessel some surgeons continue torsion until the coats rupture (unlimited

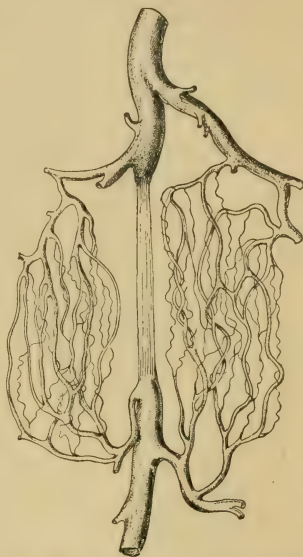
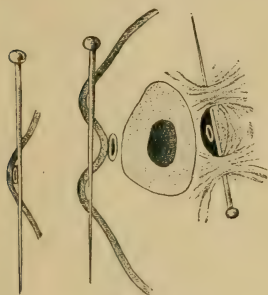


FIG. 161.—Figure showing restoration of blood supply by collateral vessels after ligation of main trunk; from a preparation of the femoral artery of a large dog eight months after ligation.

torsion). If the vessel is a large one, it should be held with narrow forceps, applied transversely, while the torsion forceps, held parallel to the long axis of the vessel, are quickly turned in one direction. As in ligation, the middle and internal coats are ruptured, and become induplicated; the external coat being stretched and twisted forms a kind of cap, which covers the clot, and gives it much greater firmness. Ligation, however, is always more certain than torsion. In arterioles of considerable size, moreover, the fibrous coat may untwist, giving rise to secondary hæmorrhage.

Forcipressure by means of artery forceps has largely replaced other means of checking bleeding. It consists in applying to the mouths of divided vessels special forceps (Wells' form is the best), which are left in position for a varying time, sometimes until the vessels are blocked by clot, sometimes only until ligatures can be applied.



FIGS. 162a, 162b.—Method of practising acupressure.

If during operation a small artery is divided forceps are immediately applied. By using a number incisions may be made through very vascular tissues with little interruption or loss of blood. To keep the operative field clear they are held to one side by an assistant. It is not necessary that all should be left in position until the end of the operation; arteries of very small dimensions, if compressed for a few minutes, no longer bleed when the forceps are removed. Should a large vessel be divided, it can be grasped and closed

with Wells' forceps, and immediately ligatured; this prevents the seat of operation being obscured with blood.

Needless to say, forceps, threads, and instruments must all be aseptic, an indispensable condition if one wishes to effect primary union or prevent accidental infection.

Acupressure never found much favour in veterinary practice as compared with human surgery, because animals are too difficult to control. At the present day it has lost much of its value, inasmuch as materials for ligaturing vessels are available which can be left permanently in position without danger. Acupressure is effected by thrusting a pin vertically into the soft tissues about three eighths to three fourths of an inch from the artery, carrying it in a horizontal direction over or under the artery, and causing it to emerge a similar

distance on the opposite side of the vessel. The opening of the artery is thus pressed either against soft parts, or, better still, against a bone (see Figs. 162*a* and 162*b*). When this is ineffective or impossible to carry out, two needles are employed, one passed below, the other above the vessel.

VIII.—BANDAGING AND DRESSING.

SINCE the introduction of antiseptic wound treatment dressings have played a much more important part than formerly, when open wound treatment was the usual custom. They not only shield the wound from infection and absorb wound secretions but favour healing by primary intention, and retain soft parts in contact very much as callus formation fixes the broken ends of bones. Dressings are also useful to retain given parts in predetermined positions and to exercise pressure. Unfortunately, in veterinary surgical practice, dressings cannot always be applied or made secure owing to the patient's restlessness, or the position of the wound.

The best materials for dressings are aseptic gauze or tarlatan, cotton wool, lint, tow, wood wool, and prepared peat. Cotton wool and gauze containing boric acid (45 per cent.), or carbolic acid (5 per cent.), or the double cyanide of mercury and zinc (3 per cent.), and carbolised tow are much used. They may be obtained ready for use.

Compresses may be of linen, cotton, flannel, etc. To cause them to fit properly without creasing they must often be slit at the edges. Dressings and compresses are secured in position in various ways, the commonest being by the use of bandages. These were formerly of linen or flannel, but for surgical purposes nothing surpasses calico, tarlatan, or cotton bandages which can either be cut of suitable size and length from a large piece of stuff or, better still, bought ready for application from the surgical apparatus dealers. In addition to cheapness they have the advantage of adapting themselves readily to irregularities of surface and of being very absorbent. Flannel bandages stretch irregularly in use, and as they soon lose their elasticity finally become wrinkled. Knitted bandages are very elastic and even after long use may by proper treatment be rendered almost as effective as when new.

Bandages intended for fixing parts immovably in position may be saturated with dextrin and dried. They can also be bought ready prepared, requiring only to be thoroughly moistened before use, when the turns adhere strongly, forming practically one mass. To

promote absorption of extravasated fluids elastic bandages are very useful. Some are made of elastic thread covered with cotton or



FIG. 163.

silk, others of pure rubber; the latter, on account of their durability and the ease with which they can be cleansed, are to be preferred in spite of their higher price. By intelligent application excellent results may be obtained with these bandages, though careless use of them may also do great harm. The most important point is to

apply them with equal pressure throughout. A very good plan is for the operator first to test the effect of the bandage on his own person, for example on the arm. Even with apparently slight pressure he will soon find it unbearable. As such elastic bandages cannot safely be placed in unskilled hands, and as continued pressure is often desirable, elastic stockings or gaiters can be used. They may be safely applied by any groom provided they fit properly in the first instance.



FIG. 164.

As a rule bandages should not exceed $2\frac{1}{2}$ to 4 inches in width

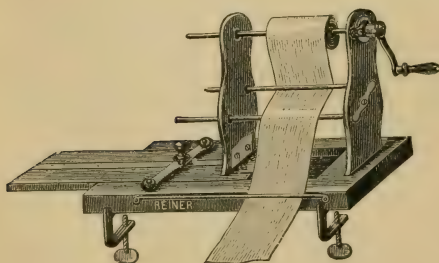


FIG. 165.

except such as have to be applied to the horse's body. The more slender the part to be bandaged the narrower must be the bandage, it being particularly difficult to apply broad bandages without producing creases, especially in the neighbourhood of joints. Before appli-

cation the bandage must be rolled; one end is first folded several times on itself, forming a small cylinder which serves as an axis for further rolling; the best method is shown in Fig. 163.

Bandages may be either single, double, or many tailed. The single ended bandage, forming a single roll, is that most in use. The double ended (Fig. 164) is rolled from both ends towards the centre, as is the multiple bandage, which, however, is now seldom seen. A very useful apparatus for rolling bandages is that shown in Fig. 165.

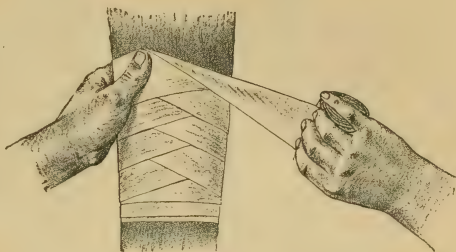


FIG. 166.

Bandages should always be applied from the periphery towards the centre, never in the opposite direction, which would lead to congestion of the veins and lymph vessels.

This precaution is often overlooked, the operator commencing in the middle of a limb. The simple experiment of applying a bandage to the middle of the forearm will soon convince anyone of the undesirability of this course; the veins of the hands become enormously distended. In hoofed animals

we cannot commence at the extreme periphery, but the bandage should certainly begin about the coronet and not, as is so commonly the custom, above the fetlock-joint. Simple circular turns, by which the bandage is applied to one spot alone, are now seldom employed for the reasons previously given, but they form the commencement and end of other methods. In spiral bandaging the upper

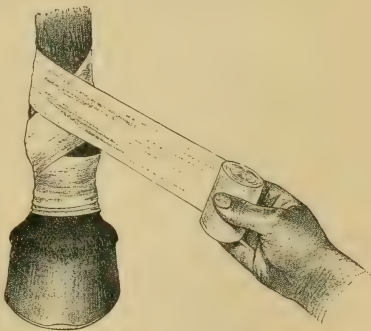


FIG. 167.

edge of each turn is covered by the lower portion of the next in order; as each succeeding turn is applied it is temporarily fixed in position by the index finger or thumb of the left hand until the next turn overlaps and fixes it in position. The first circular turn should be double to give greater security; those following take a gradual upward spiral course. On regions of conical section like the forearm,

or such as are not truly cylindrical, spiral bandaging can only be successfully carried out by using very elastic cotton bandages, otherwise the lower edges of the bandage always project. This, however, can be avoided by reversing the bandage at each turn as shown in Fig. 166, the upper and lower edges changing places. The bandage, held in the hollow of the right hand, is drawn tight, rotated, and the folded point fixed with the thumb or index finger of the left hand. The bandage is then rapidly passed round the limb, and again drawn tight, the thumb of the free hand keeping the fold flat meanwhile. These precautions, however, are scarcely necessary when using knitted, elastic, or calico bandages, especially where the latter are moist. To maintain pressure on a joint like the fetlock the figure-of-8 shown in Fig. 167 is useful. The bandage is passed once or twice around the pastern, thence obliquely upwards over the anterior surface of the fetlock, behind the joint and then forwards and downwards in a direction opposite to that of the previous turn. The position of each succeeding figure-of-8 should be slightly varied so that the entire surface of the joint is covered. To secure the degree of tension required to keep the bandage in place without causing undue pressure at any point requires some practice. Until this knowledge is acquired it is better to err on the side of slackness.

When moist applications are needed it is often best to soak the bandage before use, otherwise it contracts when wetted and may cause greater pressure on the diseased part than is intended. For the same reason moist bandages, which will afterwards be allowed to dry in position, may be drawn rather tighter than if they had been applied dry, the pressure diminishing as the moisture evaporates. It is not possible to fix dressings in all positions with bandages. In many cases considerable ingenuity is required to secure the desired fit, and the following illustrations (redrawn from Bourgelat) are intended to assist operators in this task. In the illustrations (Fig. 168 *et seq.*) indications are given of where a fold or a gusset is needed and where a portion of the cloth is to be reinforced with lining. In many places, however, even these applications do not meet all the requirements of antiseptic wound treatment. Thus after removal of the large growths which occasionally form at the shoulder in consequence of bruising with infection, Bayer preferred the following device:—He first inserted sutures of relaxation, using drainage-tubes of large size. The sutures were passed at a distance of $1\frac{1}{2}$ inches from the margin of the wound and comparatively deeply; the number inserted naturally depending on the size of the wound. A drainage-tube was then inserted and the wound closed with closely

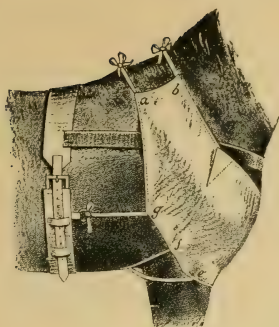


FIG. 168.

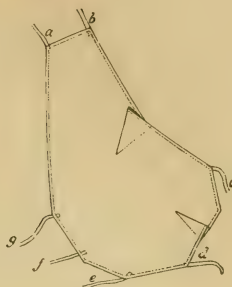


FIG. 169.

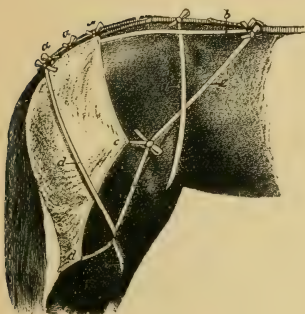


FIG. 170.

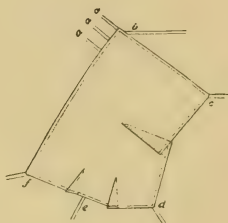


FIG. 171.

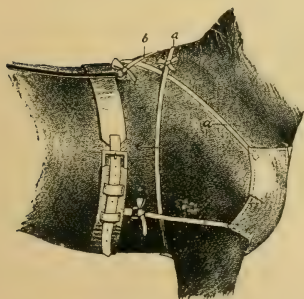


FIG. 172.

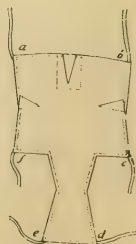


FIG. 173.

placed interrupted sutures. Bayer insisted on the importance of drawing up a fold of skin, thus producing a ridge $\frac{1}{2}$ inch high before inserting these sutures. A large piece of iodoform gauze was spread over the whole field of operation and fixed to the rubber tubes used for securing the sutures of relaxation. The gauze covered the drainage-tube. The horse was then allowed to rise and the space margined by the rubber tubes was protected with a pad of dressing material which was caused to press on the wound by thrusting broad strips of thin elastic wood, similar to that used in the manufacture of hat boxes, under the rubber tube on either side. This brought the surfaces of the wound together and facilitated union. The trifling local prominences caused by the stitches did not prevent the application of a well-fitting collar and usually disappeared in a month or two, leaving a scarcely visible linear scar.

The dressings used in *fractures of bones* may be divided into two kinds, viz. those of a temporary character—termed provisional—and those intended to be more lasting—permanent dressings. The choice for the first dressing is often very restricted, and whatever first comes to hand may require to be used. In this case broad strips of linen or even of sacking are sometimes first applied as a padding and support, and the splints, formed of flat pieces of wood, are applied on either side of the long axis of the bone and fixed in position by cords or straps. Pieces of wood may be replaced by bundles of straw. The broken part being thus protected the horse should be removed as rapidly as possible to the stable, and the permanent dressing applied. If time permit the supporting pieces of wood may be sewn between linen pads. To increase the firmness of the dressing rolls of straw, lengths of sole leather, straw board, or pieces of lead moulded to the shape of the part, can be employed in place of wooden splints.

Permanent dressings are prepared with starch, dextrin, plaster, tripolith, glue, gutta-percha, plastic cardboard, and poroplastic felt. When applying any of these care must be taken that the broken parts are first replaced as nearly as possible in their natural positions, and so retained until the dressing has become quite hard. The dressing must not press unduly on any point as this would cause sloughing of the skin, a complication specially liable to occur where prominent bony processes have to be included in the dressing. The portions to be covered and their immediate neighbourhood are therefore first supported by the application of a sheet of linen, over which wadding or some soft material is thickly applied and is retained in position with a soft bandage. Instead of wadding, soft flannel

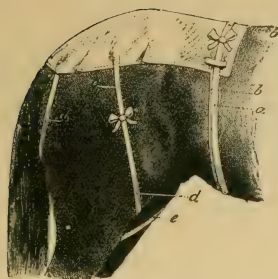


FIG. 174.

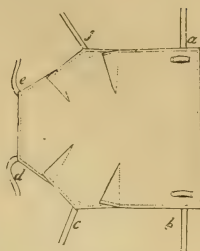


FIG. 175.

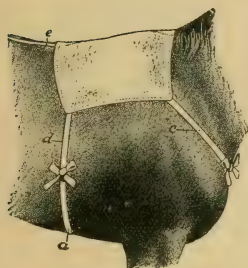


FIG. 176.

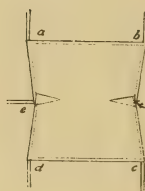


FIG. 177.

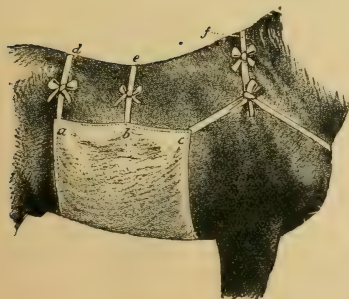


FIG. 178.

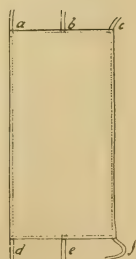


FIG. 179.

bandages can be employed; these perhaps fit better and are preferable. After thus filling up all irregularities of contour and bringing the dressing to a level surface, the permanent bandage, impregnated with some hardening material, is applied.

A common error is to apply the dressing to the fractured point alone. It is, however, absolutely necessary to extend it upwards beyond the next joint and downwards as far as the hoof or claw. Any weight thrown on the limb is thus transferred to the bandage, which acts somewhat like a cylindrical crutch, the broken bone being relieved of pressure and preserved from any movement likely to prevent union.

In applying *starch bandages* the parts are padded as described, and cardboard splints, rendered pliable by immersion in hot water, are applied. These are fixed in position with bandages completely saturated with starch. Some operators prefer to omit the cardboard splints. The gravest disadvantage, however, of this dressing consists in the fact that it requires twenty-four hours to become thoroughly hard. Starch may advantageously be replaced by ordinary glue, prepared as for carpenters' use. Dextrin bandages are applied like starch bandages but are somewhat dearer. The hardening mixture is usually composed of: Dextrin 100 parts, spirit of camphor 60 parts, water 500 parts.

Glue bandages are sometimes used, but harden rather slowly. Bandages or strips of linen are smeared on one side with melted glue, dried, and rolled up with the dressed side outwards; they are immersed in hot water just before application. Another method consists in thoroughly saturating ordinary bandages in hot thin glue immediately before use.

Pitch bandages are prepared by drawing long strips of linen through fluid pitch and hanging them up to cool. In use comparatively short lengths are applied at one time as each must be softened and made adhesive by warming. They are extremely unpleasant to handle.

Water glass is utilised for permanent dressings by painting an ordinary bandage with a solution of water glass as each turn is applied, or a very loosely rolled bandage may be saturated with the fluid before use. This dressing hardens more quickly than starch, but not so rapidly as plaster or tripolith. It is, however, lighter and more elastic than plaster. Water glass solution, when mixed with chalk, magnesite, Portland cement, etc., produces a stronger dressing, which also hardens more rapidly.

The most generally useful, however, are *plaster* and *tripolith*

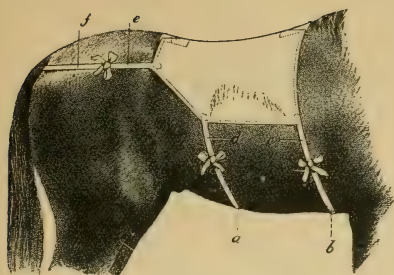


FIG. 180.

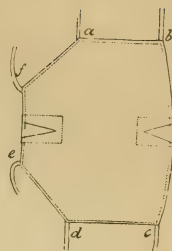


FIG. 181.

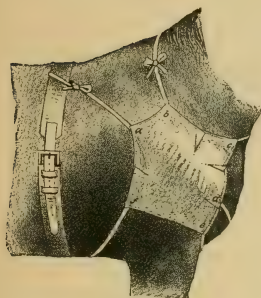


FIG. 182.

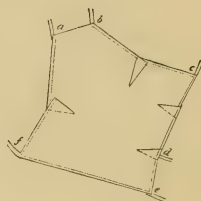


FIG. 183.

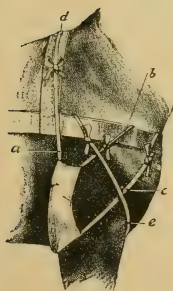


FIG. 184.



FIG. 185.

bandages. Modellers' dry plaster is rubbed into ordinary loosely woven bandages which are then rolled up, care being taken that as large a quantity as possible of the plaster is retained in the material. Just before use they are saturated with water (preferably containing a little dissolved alum, which hastens setting); they are then gently squeezed and at once applied to the parts, which have previously been padded as above described. The first folds should be applied around the free extremity of the limb and bandaging continued upwards, care being taken not to use much pressure. The piece of linen placed next the skin should extend beyond the limits of the bandage so that when the latter is complete the edges of the linen can be turned up after the manner of a cuff, enveloping the wadding or other padding material. This gives the dressing a rounded edge, and prevents any pressure on or rubbing of the skin. After complete application the surface of the dressing may be smoothed with the wet hands, or some thin plaster may be spread over it and smoothed off. Depending on its thickness the bandage sets in from fifteen to thirty minutes, during which time extension or flexion of the limb must be prevented. Plaster of Paris, if long kept or allowed to become damp, sometimes fails to set, but a little care in storage will prevent this. If desired, setting may be delayed by adding glycerine to the water used in mixing the plaster. To further support the dressing thin pieces of wood or splints of zinc or tinned iron may be inserted between the layers.

Instead of pure plaster a mixture of one part cement to two or three parts of plaster has been recommended. It appears to present no special advantages.

Tripolith, a grey powder the composition of which is unknown, is sold commercially. It hardens in much less time than plaster, and has the advantage of keeping well, even in open vessels. Dressings made with it are lighter and cheaper than those made with plaster, but as it hardens so very rapidly only one or two bandages should be moistened at a time.

All the above dressings can be made waterproof by varnish or shellac solution, which also gives them greater durability. While the plaster is setting it is absolutely necessary that the limb should be retained in the proper position, as any movement breaks and therefore usually entirely spoils the dressing. For this reason small animals must be kept lying; larger animals should be placed in slings.

These dressings, especially when of plaster, are often very difficult to remove, especially if one wishes to remove the bandage in two



FIG. 186.



FIG. 187.

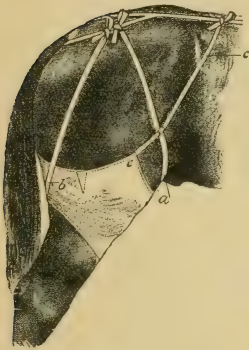


FIG. 188.



FIG. 189.



FIG. 190.

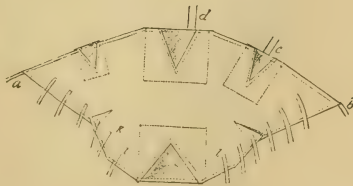


FIG. 191.

parts so as again to utilise it. To facilitate the operation special scissors have been designed, but they are very costly and rapidly become worn, while the same object can be attained almost as well, though somewhat less rapidly, with a strong pocket-knife. The line



FIG. 192.

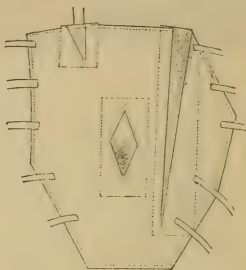


FIG. 193.

through which the incision is to be carried is first thoroughly moistened with warm water or, better still, with hydrochloric acid. In the latter case, of course, the instrument used for cutting suffers very considerably.



FIG. 194.

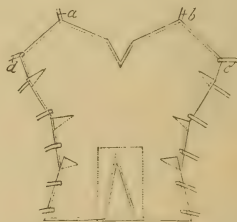


FIG. 195.

Gutta-percha dressings are less frequently employed in veterinary surgery on account of their cost. The material is in the form of flat plates, which become plastic on immersion in warm water, and can then be pressed closely in contact with the injured part, which should first be well oiled. The soft mass adapts itself with the greatest

facility to all prominences and depressions, and rapidly becomes hard under a stream of cold water. The advantages of gutta-percha are its slight elasticity, the ease with which it can be kept clean, its impermeability to fluids, and the facility with which it can be removed. Moreover, the same material may be used repeatedly, so that its first cost is really the chief objection. For small animals like dogs it is particularly useful, and in fracture of the lower jaw in larger animals it renders excellent service, a kind of hollow splint being formed, in which the jaw is embedded.

Poroplastic felt consists of felt impregnated with a resinous solution. It is made in sheets of varying size and thickness up to three feet square and $\frac{3}{8}$ inch in thickness. By immersion in boiling water or exposure to dry heat it becomes quite plastic, and may readily be moulded to the shape of the injured part. It becomes firm on cooling, but a "setting" process continues for some time afterwards, so that its greatest strength is not attained for six or eight hours. Its porous character readily permits of transpiration, and the skin is therefore much less apt to become macerated by retained perspiration as occasionally happens when gutta-percha splints are used. The writer has seen very excellent results from the use of this material in the setting of fractured limbs in racehorses.

IX.—MASSAGE.

THE term massage includes various forms of mechanical treatment, which, according to the demands of the case in hand, are either applied singly or in combination, in order to bring about particular curative results. We may distinguish—

1. Gentle stroking of the diseased parts with the fingers or open hand in the direction of the flow in veins and lymph vessels, that is, from the periphery towards the centre. The maximum pressure to be applied in such case should at first not exceed that produced by the weight of the operator's hand.

2. Brisk rubbing or pressure followed by stroking from the periphery towards the centre.

3. Beating of the parts with the open hand or fist, or with the edge of the hand, or a special percussion hammer.

4. Kneading, in which the affected part, usually a muscle or tendon, is lifted as high as possible with one hand, and then squeezed in precisely the same manner as one would compress a moist sponge to squeeze out its contents.

5. Active and passive movements.

To prevent formation of pustules at the roots of the hair, which would put a stop to further massage, it is usual in human practice to shave the affected spot and coat the parts with some lubricant, but this is not absolutely needful. According to the effect produced massage is applied for periods extending to an hour or more daily, provided, of course, that the reaction in the affected parts permits of it. At first massage generally causes pain, which, however, disappears on each occasion during the process, and is replaced by a pleasant feeling of warmth, flexibility, and increased power in the parts.

From the above it will be seen that massage favours increase of bodily strength and endurance, but its best effects can only be obtained by practice and by a thorough knowledge of the pathological processes to be combated, the exact anatomy of the diseased parts, and the physiological effects of the different massage manipulations. Experiment shows that the effects vary, similar manipulations being irritant or soothing, inclined to produce or to dissipate congestion, and to alleviate or arouse pain, according to the idiosyncrasy of the patient. The operator must first clearly conceive the changes he desires to effect in the diseased parts, as only then can he reasonably expect to effect improvement, or even to know whether massage is likely to be of benefit apart from choosing the exact system to be followed in the case in question.

The action of massage depends on its favouring and increasing absorption, accelerating circulation, and relieving pain. By stroking centripetally, not only is circulation in the collecting vessels locally stimulated and tension relieved, but mechanical congestion in parts removed from the centre is lessened and exuded lymph absorbed, while extravasations in the tissues themselves are distributed over a larger area, are brought in contact with numerous absorbents, and are mechanically assisted in entering them. For these reasons it is best to commence not at the diseased spot itself but on the central side of it, and gradually to approach the diseased spot in order to first clear a space, into which the exudate or extravasation may more readily flow.

Mosengeil's experiments prove it possible to remove fluid even from joints by pressure and stroking. He injected Indian ink into the synovial cavities of rabbits, and in two or three minutes reduced the joints to their normal form by massage. On *post-mortem* examination the Indian ink was found in the nearest lymphatic channels, vessels, and glands.

Massage promotes active absorption, diminishes swelling of tissues, and therefore pressure on the sensory nerves they contain, a fact partly explaining the decrease of pain. Massage also directly stimulates nerves, at first increasing, but afterwards diminishing their irritability. Newly formed adventitious tissue and vessels may be broken down by powerful pressure and rubbing. The extravasate thus produced, together with the cells of the broken down tissue, may be rapidly absorbed.

Infiltrations may be dispersed by repeated and long continued massage, and callus formations, so long as they are not of bony hardness, may be markedly diminished.

Muscles are stimulated to contraction, which, as is well recognised, constitutes an important factor in favouring absorption. Not only healthy but relaxed and semi-paralysed muscles again respond to stimulation, as shown by the electric current, a fact explained by the increase in supply of nourishment to the part. Muscular exhaustion following exertion is soon removed by kneading, both because metabolic products which accumulate in muscles during work are more rapidly absorbed, and because at the same time nutritive material is brought to the parts. The capacity of the muscle for exertion may even become greater than it was before the period of exhaustion set in.

Massage is of special service in diseased conditions dependent on hyperæmia, extravasation, exudation, thickening of tissue, adhesions, in short, on the results of aseptic inflammation, the products of which therefore not being of bacterial origin may be absorbed into the blood without producing bad results. Massage may be resorted to in animals affected with aseptic inflammatory swelling resulting from pressure, thickening of the skin and subcutaneous tissue of the extremities, bruising of the margins of joints, the early stages of exostoses, periostitis, inflammation of tendons and tendon sheaths, adhesions, distension of synovial and mucous bursæ, induration of the udder, impaction of the bowels, tympanites, etc. In the treatment of most of these diseases friction, which we must now regard as a kind of massage, has been utilised since ancient times. It is true that the stroking or rubbing is as often as not in the opposite direction to that of the circulation, and absorption, if occurring, must take place by collateral paths, inasmuch as the diseased spot lies between the material which is thus pressed towards the periphery and the centre of circulation. Furthermore, rubbing differs from stroking, inasmuch as considerable pressure is employed, and new tissue and recently formed vessels may quite possibly be

broken down, the further changes then occurring as above noted. The same is true of the system of pressing on and rubbing recent exostoses with a flat piece of wood, which was customary in former times, but the comparative inefficiency of this rudimentary massage lies not so much in the fact of the operator failing to observe the proper direction as in his altogether neglecting treatment until far too late.

Long ago Bayer pointed out that in veterinary practice we cannot expect the extensive and successful application of massage which obtains in man. We have already noted that in man the hair is removed and the skin lubricated to prevent pustular eruption. In animals, however, we cannot shave an entire limb, and even if the hair were removed we are able to apply massage in the proper centripetal direction only in a few places, like the neck and back ; at almost all other spots where massage is to be employed we are forced to work against the direction of the hair, which is very difficult. Bayer attempted to overcome this difficulty by the use of massage rollers consisting of small hollow cylinders covered with, or entirely constructed of, rubber. Such instruments, however, cannot replace the hand, which so readily adapts itself to the varying contour of the body and allows so much more perfect an estimate to be formed of the pressure employed than can be obtained in any other way. The exact degree of pressure to be used is difficult to judge, and can only be learned by practice and experience. Excess causes injury and delays improvement, as one often sees when the treatment has to be left in lay hands. Bayer preferred to forego massage altogether rather than leave the manipulation to the owner or coachman. The pain caused by pressure and kneading, especially where much force is employed, sometimes renders it necessary to resort to means of restraint. The action of massage is considerably increased by substituting for mere lubricants ointments containing substances which promote absorption.

Active and gradually increasing exercise produces similar results, chiefly by improving blood and lymph circulation and increasing metabolic changes.

Massage is applicable to a large number of diseases and their sequelæ. In infiltration of the cornea with milky deposit, not due to cicatricial formation, massage is applied in the form of circular and radiating rubbing. As horses with disease of the eye usually resist interference, it is necessary to proceed with caution. The hand is first passed over the side of the face furthest removed from the eye and gently advanced **[**more and more closely to the diseased

eye. Placing the points of the index and middle fingers very lightly on the upper eyelid the lid is caused to move over the surface of the cornea with circular and radiating movements. Very good results may be obtained in this way alone, but a small quantity of some resorptive, like the yellow or red oxide of mercury ointment, may, in addition, be introduced into the conjunctival sac. Bayer also recommended iodoform ointment and iodoform in powder.

Massage is particularly valuable in inflammation of tendons and in recent cases of thickening of the tendon, but only when the condition is circumscribed. When the entire tendon is thickened the effect is much less satisfactory. On the other hand, excellent results may be obtained in thickening of the flexor pedis perforans, though considerable patience and perseverance are required. The foot being lifted, the upper part of the thickened spot is grasped between the thumb and fingers and kneaded, at first very gently, afterwards more strongly, but without excessive pressure. The operator gradually works further down. Manipulation being complete, the horse is exercised for a short time and a wet bandage applied.

In dispersing the soft enlargement resulting from peri-arthritis the thumbs are most employed. The periphery is first manipulated, the thumb being applied to the soft tissue with considerable pressure. This tends to break up the soft deposit, which is then further dispersed by powerful stroking movements with the thumb. The horse is afterwards exercised. Passive movements of the joint can only be carried out satisfactorily in small animals.

Vogel recommends massage in various diseases of the udder. Old practitioners appear to have recognised its good effects, as shown by their advising frequent milking, which really acts as a kind of massage. Vogel, however, lays stress on the suggestion that the veterinary surgeon himself should first carry out the operation, because rough or excessive manipulation often causes a relapse. The hard masses of tissue are grasped and kneaded or rolled under the fingers.

Massage of the abdomen is most useful in ruminants and dogs. In ruminants it arouses peristalsis, so that in fifteen to twenty minutes the overloaded and torpid rumen may often be set in action. The best method of manipulation is to station on either side of the abdomen a man who, laying his clenched fists close together on the animal's side, makes regular powerful kneading movements from below upwards. Where severe tympanites, or obstinate impaction of the omasum exists, or rumination has been suppressed for several

days, the power of the operator's arms is insufficient, and Vogel suggests the operator sitting on a stool and using the soles of the feet. Counter-pressure must, of course, be exercised on the right side.

In dogs the abdomen can be massaged with the animal either in the upright or prone position. The points of the fingers alone may be used, or where over-distended portions of the bowel can be felt the open hands may be employed. The coil of intestine is grasped with the fingers and the contents broken down and forced onwards. With the animal in the standing position one operates in a similar way, the points of the fingers being slowly pressed from either flank into the depths. Portions of bowel may be kneaded and peristalsis aroused by suddenly releasing the parts after subjecting them to steady pressure. In this way even severe constipation may be cured and more serious operation often avoided.

X.—PHLEBOTOMY.

By phlebotomy is meant the surgical opening of a vein for the purpose of removing blood. Although bleeding is almost invariably practised on veins, arteries may be utilised for the same purpose, and the old term blood-letting included venesection or phlebotomy and arteriotomy. Bleeding from capillary vessels is usually effected by scarification or the application of leeches.

Bleeding may be divided into general and local. General bleeding consists in removing a large volume of blood with the object of lowering blood-pressure throughout the body; local bleeding, on the other hand, is undertaken to reduce the quantity of blood in the part operated on or in its immediate vicinity, *i.e.*, to improve the conditions in a circumscribed area.

In former times bleeding was popular in all acute and feverish conditions, and was so excessively practised that a reaction naturally set in. It has now almost fallen into desuetude, a result accelerated and confirmed by the entirely different views now held as to the value of general bleeding. In bacteriological laboratories, of course, bleeding is a necessary preliminary to the preparation of protective sera, and is also resorted to for obtaining blood for microscopical or bacteriological experiments. The periodical bleeding of animals in spring to keep them in good health is still practised in a few parts of the country, but is rapidly dying out. The innate vitality of ancient superstitions is well illustrated by its having survived so long.

It would appear that venesection plays no great therapeutic rôle, and when we recall that it is contra-indicated both in extreme youth and age, in constitutional weakness, pregnancy, etc., there is little wonder if it is now comparatively little practised. Its most important indications are in dangerous conditions resulting from marked disturbance of circulation in important organs like the lungs and brain. It is also valuable in other diseases like laminitis and lumbago, in which, however, its exact *modus operandi* is obscure. It is known that the reduction in quantity of the circulating fluid is at once followed by diminished blood-pressure in all the vessels and changes in the circulation favourable to the relief of local congestion. The blood withdrawn contains a large quantity of nutritive material and blood-corpuscles, both of which are of great importance to the organism when struggling with microbic infections; in such diseases, therefore, blood-letting is seldom advisable. As it is also known that inflammatory processes in the body most commonly result from infection, this fact renders blood-letting still more questionable as a means of combating inflammation.

On the other hand, a certain amount of infective or toxic substances is also removed with the blood, but as general bleeding weakens the patient, and as active resorption from the great body cavities follows, it may happen that a greater amount of injurious material is eventually absorbed than is removed from the circulation.

As mentioned, active absorption from the tissues and body cavities follows bleeding, and the fluid constituents of the blood are thus replaced. This explains the value formerly attached to the practice as a means of promoting resorption. In opposition to this is the fact that the proportion of water in the blood is thereby relatively increased, and with it the tendency to fresh exudation. Experience shows, in fact, that little can be expected of bleeding in this direction.

Bleeding is followed by a temporary increase of tissue metabolism, as shown by augmentation in the quantity of nitrogenous compounds and phosphoric acid voided in the urine. Such a result can scarcely be interpreted as favouring recovery.

At the present day horses and cattle are almost invariably bled from the jugular vein; formerly it was the custom to bleed from the subcutaneous thoracic vein in diseases of the chest, from the mammary vein in diseases of the udder, and from a digital vein in diseases of the foot, but experience slowly convinced operators that no advantage was thus gained. The jugular vein is now almost invariably chosen because it is easy to find, conveniently situated

as regards height, etc., and while blood-pressure within it is low, a considerable volume of blood may be obtained in a short time. It lies in the "jugular furrow," formed above by the mastoido-humeralis and below by the sterno-maxillaris muscles. Beneath the skin and loose connective tissue lies the panniculus, which, though very thin in the upper portion of the neck, attains half an inch in thickness in the lower. In the upper half of the jugular furrow "the vein rests on the subscapulo-hyoideus muscle, which there separates the vessel from the carotid artery; but in the lower half the vein rests on the side of the trachea, and is in direct contact with the carotid, which lies above and slightly internal to it." The point chosen is the junction between the upper and middle thirds of the neck,

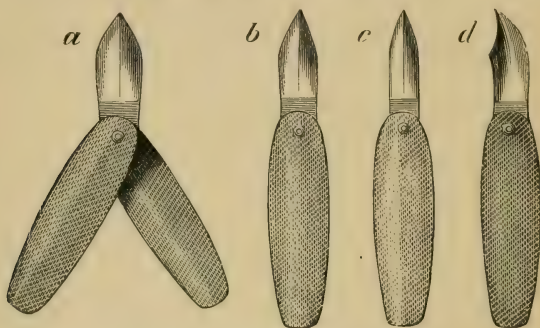


FIG. 196.—Lancets for venesection.

where the subscapulo-hyoideus muscle intervenes between the vein and the carotid artery, which is therefore less likely to be injured.

The average quantity of blood abstracted at one time is, in the ox, 10 to 16 pints, the horse 8 to 12 pints, the pig 1 to $1\frac{1}{2}$ pints, sheep $\frac{2}{3}$ of a pint, and dog $\frac{1}{2}$ a pint, in fowls $2\frac{1}{2}$ to 10 fluid drachms; individual peculiarities, however, must be taken into account in each case.

Instruments. The simplest instrument is the lancet. Several forms are used, the varieties of which are shown in Fig. 196. The English lancet (*a*) has a relatively obtuse point; the German (*b*) is somewhat more acute; in the Italian (*c*) the blade is narrower from the commencement, and the cutting edge relatively long and slender; *d* is the sabre-shaped or abscess lancet, having one convex, and one concave cutting edge.

To bleed with the lancet, though apparently easy, requires con-

siderable practice ; the varying thickness and resistance of the skin in different animals making it difficult to judge of the exact amount of pressure required to open the vein without transfixing it.

For this reason other instruments have come into use. The most popular of these is the fleam (Fig. 197). The handle extends somewhat beyond the insertion of the actual cutting part, and is intended to prevent the instrument entering too deeply. Sometimes the back

FIG. 198.

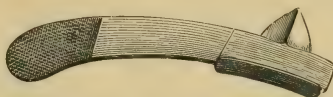


FIG. 199.



FIGS. 198, 199.—Fleams.



FIG. 197.—Simple fleam.

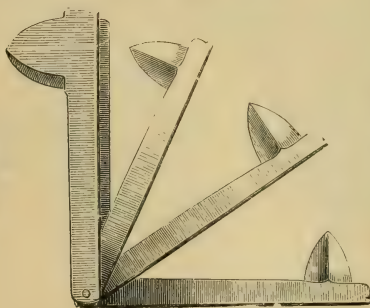


FIG. 200.—Case of fleams.



FIG. 201.—Blood-stick.

of the handle is provided with a broad surface (Figs. 198 and 199) on which the blow of the blood-stick is delivered. Combined fleams having a number of blades in one setting are also common (Fig. 200). The fleam is caused to penetrate the vein by a sharp blow from the hand or blood-stick (Fig. 201). With the latter the necessary force can better be estimated, and the inconvenience of either failing to penetrate the vessel or completely transfixing it equally avoided ; in delivering the stroke the arm should not be moved as a whole, but only from the elbow.

Spring fleams (Figs. 202 and 203) are intended to overcome the foregoing difficulty. The case of the fleam is provided with an opening (*C*) for the passage of the fleam (*F*), which is withdrawn into the case and set by drawing back the cocking lever (*A*), leaving the plate (*C*) free for application to the vein. Having placed the instrument accurately in position the operator depresses the trigger (*D*), releasing the fleam, which makes a rapid to-and-fro movement, dividing the skin and opening the vein. As the instrument is readily placed in position, always cuts in the right direction and to the right length and depth, and can be regulated, it continues popular, despite its being complicated and difficult to clean.

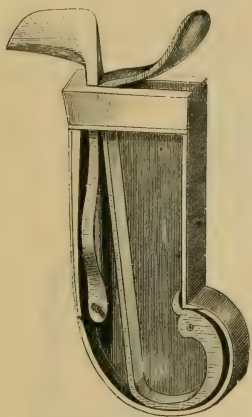


FIG. 202.—Spring fleam; old form.

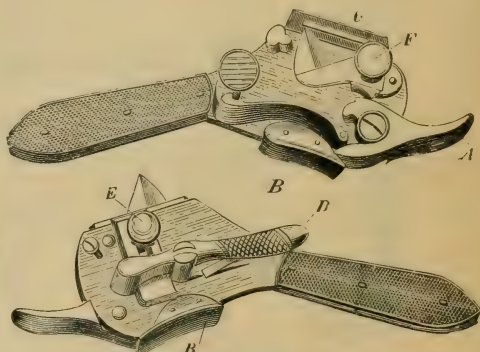


FIG. 203.—Spring fleam; later form.

When bleeding oxen a bleeding string is required, *i.e.* a cord provided at one end with a ring. By passing the cord round the base of the neck and through the ring and drawing it tight, temporary engorgement of the jugular is produced, which facilitates operation. Except for stallions and very heavy, fat animals the cord is not required in equine practice.

The blood should be received in a vessel of measured capacity, so that the amount removed may be accurately known.

The skin wound is closed with a pin suture, or the ordinary interrupted suture. A word of caution is required against using hairs from the mane or tail to complete the pin suture, as was the

old fashion. These hairs not infrequently infected the wound and produced phlebitis.

Operation on the horse. When using the spring fleam it is of little importance on which side the operation is performed, though some slight advantage accrues from selecting the right. The same is true of the lancet, but the fleam can be used most conveniently on the left. At the junction of the upper and middle thirds of the neck a small area of skin should be shaved and disinfected (Figs. 204 and 205), this preparation minimising the danger of



FIG. 204.—Bleeding with the spring fleam ; off side.



FIG. 205.—Bleeding with the spring fleam ; near side.

phlebitis. The head is held slightly elevated by an assistant. Troublesome horses may be twitched, and the fore-foot on the side of operation may be lifted. When using the ordinary fleam the horse's eyes should be covered, because at the moment of striking the blow the animal is apt to start, defeating the operator ; but of course this is not likely to occur in using the lancet or spring fleam. Having cocked the spring fleam, the operator stands beside the animal's shoulder, and with the thumb or fingers of the left hand compresses the vein, causing it to be distended.

Should there be any doubt as to the exact spot to select, the

pressure may be relaxed and repeated once or twice, when the rising and falling of the vein will render its position evident. Immediately it appears clearly the plate of the fleam is adjusted just over it and parallel with its long axis, the trigger is gently pressed, and the incision made. The fleam is then removed, but compression of the vein below the incision must be continued until the necessary quantity of blood has been obtained.

If the vein has only been stabbed, the blood flows in drops or in a very thin stream. In such case operation should not be repeated at the same point. Sometimes the blood at first flows in a thick stream, but soon diminishes in spite of continued compression. This is due to the skin having slipped to one side and covered the wound in the vein, or to a fragment of subcutaneous tissue having interposed itself. By slightly moving the skin or the horse's head, or by inserting the finger in the animal's mouth and so causing it to make chewing movements, the flow can be restored. Occasionally the vein is opened over a valve, which falls into the wound and obstructs the stream.

Jets of bright red blood mixed with the darker stream show that the carotid has been opened; and if the wound be large the animal may bleed to death, unless the carotid be immediately ligated. The vessel should be firmly compressed by an assistant, the existing cutaneous wound enlarged for a distance of three to four inches, the subscapulo-hyoideus muscle divided, and the carotid exposed by blunt dissection. The artery should be grasped with the fingers, drawn forward, freed from the nerves which accompany it, and, on account of the collateral circulation, doubly ligated. Care must be taken in separating the recurrent and other nerves and in cleansing the wound, as injury to the nerves or irritation produced by local suppuration may be followed by cardiac disturbance, dyspnœa, paralysis or "roaring." Other methods like continued compression of the artery and closure of the skin with sutures have been recommended. Compression might in isolated cases be followed by hæmostasis, but closure of the skin wound is dangerous. Experiment shows that a large hæmatoma usually develops, and pressure on the trachea may become so severe as to threaten suffocation.

Sometimes a small artery in the region of operation is divided, and gives the impression of the carotid having been injured. Injury of the vagus or sympathetic nerve seldom occurs. Perforation of the trachea can only be caused by gross carelessness, but if opened sufficiently for blood to enter the lungs, it might give rise to troublesome symptoms.

The low or even negative blood pressure in the jugular vein renders it specially convenient for venesection, but at the same time entails a certain danger of air being aspirated into it, with possibly a fatal result. Usually, even if the vein be not compressed below the incision, sufficient blood flows from above to preserve a slight positive pressure. But a deep inspiration may be followed by so rapid a rush of blood towards the heart as dangerously to favour the indraught of air through the wound. This is not a frequent accident, and it cannot well occur while the escaping stream of blood is strong and full; though it may happen after the stream slackens or ceases. Compression of the vessel *above* the wound, as sometimes happens from the patient leaning against the manger or on the collar shank, is favourable to the aspiration of air through the wound. For this reason the cutaneous wound should always be sutured.

The sudden or rapid entrance of a large volume of air into the jugular is accompanied by a hissing, gurgling, or sucking sound at the wound, followed by intense dyspnœa, dilated pupils, pallor of the mucous membranes, and a peculiar churning noise which is heard over the heart; at once the horse staggers or sways to and fro, falls to the ground, and may die in a few minutes. At one time insufflation of air into the jugular was frequently resorted to in destroying horses. The vein was opened with a knife, a cannula or pipe-stem inserted, and the operator—of good lung capacity—with his mouth applied to the tube, blew as strongly as possible, the horse falling and dying without a struggle. The mechanism of death from aspiration of air into a vein has not been satisfactorily ascertained. It has been supposed that the spumous or frothy mixture of blood and air produces distension and paralysis of the right side of the heart and consequent arrest of the circulation.

Sufficient blood having been taken, the skin is closed either with a pin or interrupted suture. In the former case the pin is cautiously removed in thirty-six to forty-eight hours, the parts being supported with the fingers of the left hand whilst those of the right rotate and remove the pin. In closing the wound care must be taken not to exercise much traction on the edges, as this might cause separation of the skin from underlying tissues, and extensive extravasation. Similarly, if during bleeding the outer opening be obstructed, blood accumulates under the skin. Such extravasation would be of little consequence were it not that by compressing the vein it may lead to thrombus formation, and that it always supplies a favourable medium for the further development of the micro-organisms which

almost inevitably enter. Failure to remember these facts, and to observe necessary cleanliness, account for most cases of suppuration and phlebitis and the complications which follow them.

To prevent the animal injuring or infecting the wound, by leaning against or rubbing itself on the manger, etc., it should be secured on the pillar reins or tied up short. Nor should it be worked soon after bleeding, because the pressure of the collar on the vein or the rise in blood-pressure consequent on exertion may cause the lips of the wound to spring open.

In operating with the spring fleam on the left side, the instrument is held in the reversed direction—that is, with the blade pointed downwards (Fig. 205), or the vein may be compressed with the right hand and the fleam held with the left.

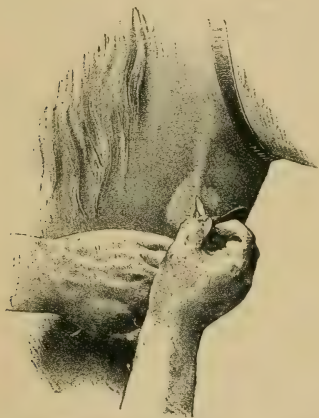


FIG. 206.—Bleeding with the lancet.

The right jugular is easier to open with the lancet (Fig. 206). The position of the operator is similar—that is, near the animal's shoulder. After wetting and smoothing the hair the vein is compressed lightly below the point of operation and caused to appear distinctly. The incision is, as before, at the most prominent point and close to the operator's fingers, because here the vein is more or less fixed. The lancet is thrust inwards and slightly upwards,

so as to produce a sufficiently large wound, though care must be taken not to absolutely slit open the vessel, as is sometimes done from over-anxiety. It then becomes difficult to stop the flow, and it may be necessary to ligate the vein, in addition to which there is danger of air entering the vessel. The incision should be in the centre line of the vein; the upper (or posterior) aspect of the vessel must be avoided, as injury to the carotid artery may readily result from incisions in this direction.

In using the ordinary fleam (Fig. 207) the operator, standing opposite the animal's left shoulder, holds the fleam lightly between the index finger and thumb of the left hand, compresses the vein with the other fingers, and with a short, smart blow from the blood-

stick, or failing this, from the edge of the right hand, drives the fleam into the vein. The fleam must be held exactly at right angles to the skin over the highest prominence of the vein, otherwise the vessel will be opened on one side or the instrument will slip past it.

Dieckerhoff and Caspar recommended a special trocar and cannula for bleeding. As this instrument had been used for some years for intra-venous administration of drugs, it occurred to them that it might be equally useful for withdrawing blood, especially where it was desirable to shield the withdrawn blood against contamination, as in preparing protective serum. The cannula has the great advantage over the fleam that it can be inserted several times at the same place. In operating, the vein is raised, the skin divided, and the vein exposed. The

operator, standing on the animal's near side, then thrusts the cannula, carrying its shield, steadily into the vein for a distance of three or four inches, when bleeding follows. Some dexterity is required, but the method is particularly useful for laboratory work, and avoids almost all the risks formerly ap-

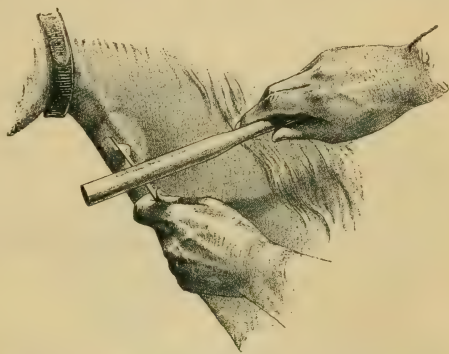


FIG. 207.—Bleeding with the fleam and blood-stick.

pertaining to phlebotomy of the jugular. When the necessary amount of blood has been abstracted, a blunt trocar is inserted into the cannula to prevent air entering the vein, and the combined instrument withdrawn. The wound is dressed antiseptically and closed with a single suture, or may be left open.

In **cattle** the jugular vein is also opened. The animal's head is raised by grasping the horns and the eyes covered. The hair is removed from the seat of operation, the bleeding cord previously mentioned adjusted, and the vessel opened just above the point of compression by means of the fleam. The operator stands as in bleeding a horse. In small cattle one may even stand on the side opposite to that of operation and lean over the animal. This method has the advantage that the operator cannot well be struck by the animal when, as occasionally happens, it kicks in a forward direction.

On account of the loose arrangement of the skin in oxen it is not necessary, though it is advisable, to insert a suture.

Bleeding from the mammary vein was formerly practised in diseases of the udder and of abdominal organs, but possesses no special advantage over bleeding from the jugular, while it is less easily carried out, and the wound is very liable to infection.

Sheep and goats may also be bled from the jugular, but as a rule the facial vein in the neighbourhood of the fourth molar is selected. It yields little blood, but this is by no means an unmitigated evil, as sheep and goats are very liable to serious symptoms after bleeding.

As in **swine** the jugular lies deep and is covered with fat, it is seldom opened, the lingual vein being preferred. A wooden rod being thrust between the teeth, the tongue is drawn forward, and

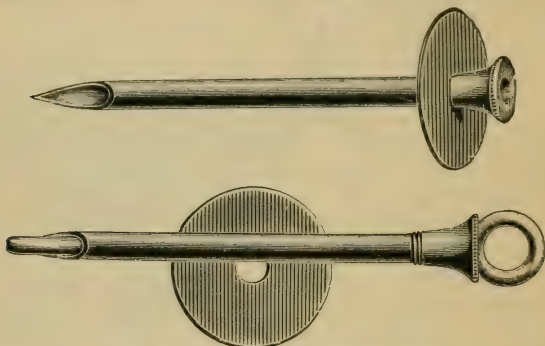


FIG. 208.—Dieckerhoff's bleeding cannula.

the vein opened just over the frænum linguæ. Bleeding ceases spontaneously. In addition the transverse facial and anterior auricular veins are occasionally opened. The internal saphena vein of the hind limb is also the seat of operation. It is compressed by applying a cord or bandage between the hock and stifle joint.

In **dogs and cats** the jugular, or the internal saphena vein of the hind limb, is the vessel usually indicated in text-books, but the operation is scarcely ever performed.

Arteriotomy. The opening of an artery is very seldom resorted to. The operation is carried out in the same way as phlebotomy, or the artery is exposed, divided, and, at the conclusion of the operation, ligated.

Scarification. Bleeding from capillaries is effected by scarification, cupping, or the application of leeches. Leeches are little used in

veterinary surgery. Scarification consists in making a number of comparatively shallow cuts in the tissue. It is seldom employed on account of suppuration and destruction of tissue frequently resulting. For cupping, which is also rarely resorted to, a scarifier or lancet and a cupping-glass are necessary. The scarificator (Fig. 209) consists of a metal box containing many small fleams and the mechanism for operating them. The blades can be raised or lowered by a screw, and the depth of incision regulated. The fleams, twelve to sixteen in number, are set and released in a precisely similar manner to the blades of the spring fleam previously described. The scarificator is applied to the shaven and disinfected skin, released, and applied a second time at right angles to its previous position so as to produce cross cuts. Cupping-glasses are hemispherical in shape, with edges ground to a true surface. The centre is pierced by a small hole, and carries a short hollow stem to which a strong rubber ball is fixed. The rubber ball on top of the cupping-glass is then compressed, the glass applied to the scarified area, and the ball released, causing a partial vacuum. When partially filled with blood, the glass is removed, emptied, and again applied until the necessary quantity of blood has been taken. A dressing is afterwards applied over the seat of operation.

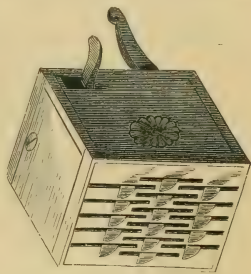


FIG. 209.—Scarificator.

In removing blood for the preparation of protective serum ordinary methods are unsuitable, because organisms may obtain entrance to the stream of blood and the receiving vessel. The vein is therefore exposed, and a trocar provided with a rubber tube connection is inserted in it. The glass cylinder to receive the blood is closed with parchment, and covered with a movable metal cap provided with an opening. All the instruments and apparatus are, of course, most carefully sterilised.

In use the parchment is pierced through the opening in the metal cap, and the rubber tube lowered into the cylinder so that the stream of blood comes as little as possible in contact with the air and forms no foam. Immediately the vessel is filled the tube is withdrawn, the cap turned round, and the opening in the paper thus covered.

Transfusion. By transfusion is meant the conveyance of blood from one individual into the vessels of another. It is only employed where fatal exhaustion threatens in consequence of severe loss of

blood or blood poisoning, especially such as follows the respiration of carbonic acid, ordinary illuminating gas, chloroform, etc. The instruments required are a knife, forceps, scissors, a cannula, and a glass funnel with rubber tube.

In mediate transfusion the healthy animal is bled into a tall vessel placed in water at blood-heat. The blood is then whipped until all fibrin is separated so that no clots may form, which might produce emboli in the vessels of the recipient. In the meantime a large vein or even an artery in the subject is opened, the cannula inserted, and some blood allowed to escape in order to expel all air from the cannula. The defibrinated blood having been filtered through fine linen is used to fill the syringe or funnel, care being again taken that no air remains in the instrument. The syringe or tube from the funnel is then connected with the cannula, and the blood passed slowly into the veins of the subject.

After transfusion it sometimes happens that the body temperature falls, cyanosis and severe dyspnoea set in, followed by hæmoglobinuria, or even death. The cause of this intoxication is probably the presence of fibrin ferment in the transfused blood. To prevent this the blood is often conveyed direct from blood-vessel to blood-vessel by a connecting rubber tube. This operation is termed immediate transfusion. Apart from the difficulties of the process and the impossibility of controlling the quantity of blood introduced, there is considerable danger of the formation of clots. Considering its risks transfusion is nowadays practically abandoned, especially as it has been shown that the dangerous symptoms depend not so much on the want of blood as on the sinking of blood-pressure. The whole value of transfusion, therefore, lies in its providing a sufficient quantity of fluid for the heart to act upon.

Similar results may be more safely obtained by subcutaneous, intra-peritoneal, or intra-venous injection of artificial serum or sterilised solution (·9 per cent.) of sodium chloride to which has been added a few drops of carbonate of potash solution. The injection of saline solution should be carried out with close attention to asepsis. The fluid should be heated to a temperature slightly above the normal body temperature of the patient; it must be injected slowly and preferably by means of a syringe provided with a two-way stop-cock and corresponding tubes. After injecting physiological saline solution, the patient must be warmly clothed and frequently fed with highly nutritive foods. Plenty of fluid should be given; warm milk, wine, brandy, meat extracts and eggs are all useful in restoring the condition of the blood.

XI.—CAUTERISATION.

THE destruction of tissue by chemical substances or by burning is termed cauterisation. Such chemicals are comprised under the general heading of caustics, whilst the red-hot iron or other heated instrument is termed the actual cautery. Cauterisation produces a scab or scar. The dead tissue is separated by reactive inflammation, and is cast off; healing follows by granulation. Apart from destroying diseased tissues and stimulating repair in strained or chronically inflamed tissues, cauterisation is often invoked merely to produce very active counter-irritation, sometimes to hasten cicatrisation, or to close bleeding vessels by causing contraction with thrombus formation, and thus to check hæmorrhage.

Chemical caustics may be divided into fluid and solid. Fluid caustics can be applied in small quantities with a brush, glass rod,

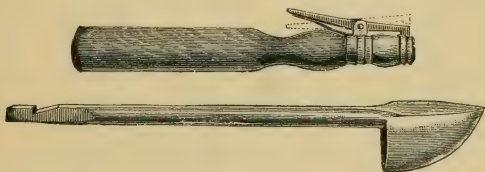


FIG. 210.—Line firing iron and detachable handle.

or pledget of cotton wool, etc., to the point to be cauterised, care being taken never to apply so much as to render possible the spread of the caustic beyond its intended position. If considered necessary exactly to delimit the extent of tissue to be cauterised the skin may be shaved, and a plastic containing an aperture of the desired size applied, or a mass of soft plaster may be formed into a roll and affixed to the skin around the point to be operated on, forming a little basin to receive the caustic and protect adjacent parts.

Of fluid caustics may be mentioned :

Sulphuric acid, which acts very rapidly and powerfully on account of the energetic way in which it removes water from living tissues and coagulates albumen. It produces a hard black scab, which remains in position a very long time.

Fuming nitric acid produces a yellow scab, which is at first softer than that produced by sulphuric acid, but later becomes dry and hard. The yellow colour is due to the formation of xanthoproteic acid, a combination of nitric acid with albumen.

Hydrochloric, carbolic, and chromic acids act less powerfully than nitric or sulphuric acid.

Among solid agents, caustic potash exercises a very marked and penetrating action. It can be applied solid or in solution. Sticks of fused caustic are to be preferred. The point is pressed on the

part to be cauterised until the intended amount of action has been produced. Caustic potash, like some caustics previously mentioned, acts by abstracting moisture from the tissues. It forms a greyish-yellow scab sometimes mixed with blood. As this scab readily breaks down and becomes fluid, the surrounding parts must be carefully protected from its effects. A special caustic is used in Vienna, consisting of six parts of caustic lime and five of caustic potash moistened with alcohol to form a paste, which can then be applied to the skin to the extent required. This paste does not run or spread.

Sublimate (perchloride of mercury) is also a powerful caustic. It destroys tissues by com-

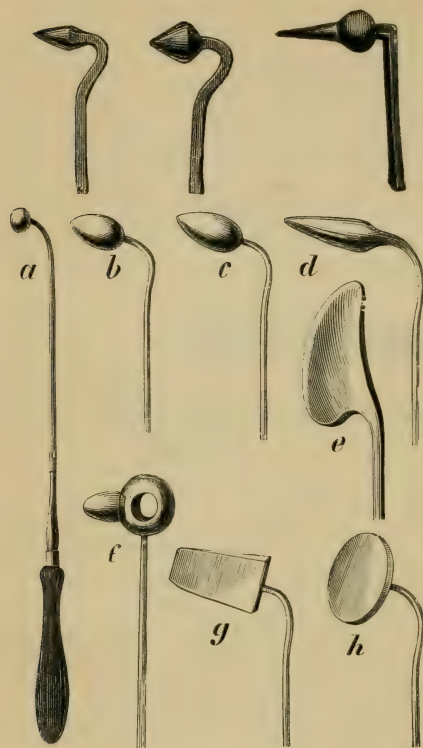


FIG. 211.—Bud, point, line, and disc firing irons.

binning with their albumen, and forms a soft grey scab, which afterwards darkens and slowly separates. Sublimate is employed as a powder, paste, or solution. Sublimate collodion consists of five parts sublimate dissolved in thirty parts of collodion.

Arsenious acid, or white arsenic, is usually employed in the form of paste. The action is slow, the scab firm and durable.

Chloride of antimony, otherwise known as butter of antimony, has a powerful action, and produces a whitish, at first soft and afterwards hard, sharply defined scab.

Chloride of zinc is an energetic caustic, and may advantageously be used by mixing one part zinc chloride with one to four parts of flour, water being added to form a paste.

Nitrate of silver and sulphate of copper are perhaps the caustics most generally employed. Nitrate of silver, or lunar caustic, has only a superficial action. The scab is at first white and soft, later becoming dark under the action of light. Sulphate of copper is cheaper than lunar caustic, and is sometimes used to destroy exuberant granulations.

The longer the caustic remains in contact with the tissues the more extended is its action, as it continues to spread from the fresh scab. Where the action proves insufficient it may be renewed as soon as the scab is shed. For destroying new growths, caustics in the form of pastilles or rods are sometimes used, an incision being made in the growth for their introduction. In other cases solutions are injected. These methods, however, are not to be commended because the range of action of the caustic cannot be controlled. Sometimes a portion of the growth is left, necessitating a second operation; sometimes the action of the caustic extends to healthy tissue with unfortunate results. The caustics, and especially the more active, produce severe and continued pain during their action.

The actual Cautey—Firing. Although less used than formerly firing continues very popular, and is employed with success in many conditions which have resisted all other treatment. Without doubt it gives lively pain, necessitates a certain period of rest, and sometimes leaves indelible marks, but these drawbacks are more than counterbalanced by its many advantages. Among the indications for the employment of the actual cautery, the most frequent are chronic affections of tendons, tendon sheaths, ligaments, bones, synovitis, sprains, luxations, exostoses, enlarged joints, and necrosis. It is also used to divide tissues, to remove chronic lymphatic thickening, to stimulate healing of fistulæ, indolent ulcers, and poisoned wounds, in the treatment of tumours, and to check hæmorrhage. Distinctions have been made between mediate and immediate, superficial and deep or penetrating firing. In mediate cauterisation, a glowing iron is brought close to the spot to be acted on so that the parts are merely heated by radiation; in immediate cauterisation, the instrument is brought in actual contact with the tissues. Surface firing, *i.e.*, firing extended areas all over,

and the application of burning pastilles (moxas) are now entirely abandoned.

The methods at present used are (1) superficial firing in the form of points or lines, the instrument not passing deeper than the



FIG. 212. —Needle firing iron with interchangeable needles.

epidermis itself; (2) deep firing in fine points, where the skin is penetrated at one or a number of spots; (3) needle firing, in which the instrument penetrates the muscle, tendon, ligament, bone or synovial sac; (4) subcutaneous firing, practised after the skin has been divided with a knife.



FIG. 213.—Dégive's needle firing apparatus packed in box.

The instruments used for line firing are provided with heads resembling wedges or triangular prisms. The cauterising margin should be slightly convex, smooth throughout and rounded at the angles; a slight curve in the stem is thought by some to be advantageous. With instruments of this form it is easy to follow

the inequalities of the surface and to ensure each part being subjected to the same action. Fig. 210 shows the ordinary form of the English firing iron. It is suitable for most purposes. The length of stem varies according to whether it is intended for use on the animal in a standing position or when cast. Messrs. Arnold make these instruments in many forms, all fitting one handle. The head of the point or bud-firing iron consists of a more or less elongated cone; for deep firing it is drawn to a much finer point. Needle firing is performed with very fine points, capable of penetrating the tissues deeply. It was formerly the custom to use stout needles, about four inches in length, which were brought to a red heat in a charcoal furnace,

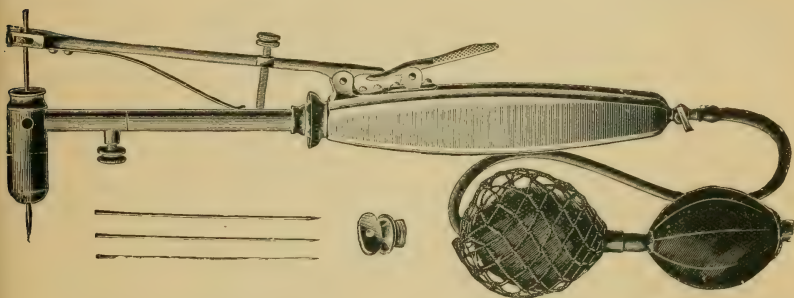


FIG. 214.—Dégive's apparatus ready for action. The reservoir in the handle is filled with sponge saturated with benzine vapour. The bellows pumps air through this reservoir. The stream of benzine-laden air is mixed with a stream of pure air controlled by the two-way tap at the base of the handle, and burns with an intensely hot blue flame in the hood. The tap at the base of the handle regulates the size of the flame, and therefore the temperature.

grasped with pincers or forceps and plunged into the tissues. These were replaced by instruments consisting of a heavy cone-shaped head, with a central aperture through which a suitable needle could be passed. The head was first heated, and when red, the needle was dropped into position. In the greater number of such instruments, however, the needles become cold very rapidly, and the large head cauterises the skin around the perforation. To protect the skin it becomes necessary to place a small disc of iron with a central aperture over the point of operation. Several instruments with movable needles have been invented. Dégive's (Figs. 213 and 214) is probably the best, though similar instruments have been produced by Bourget and De Place. It consists of a handle, which also acts

as a benzine reservoir and saturator, carrying at its extremity a small iron box with a conical base, through which is drilled a hole for the passage of the needle. This latter is held on a movable arm, which permits it either to be protruded through the base of the box or to be retracted within the latter by a spring. A bellows and benzole container supply the heat, the flame playing within the cavity of the iron box. Each time a puncture is to be made the red-hot needle is protruded from the point of the box and thrust into the tissues. The action of the spring automatically returns it to the interior of the box, where the flame almost immediately renders it hot again.

The two following firing instruments were described by the writer some years ago (see "Veterinarian," February, 1898). They have been used by him in his practice for many years, and both have been found very satisfactory. The first is Graillot's Zoo-cautery (Fig. 215).

It is an adaptation of Paquelin's, which depends for its action on the peculiar property possessed by metallic platinum, and in an even higher degree by platinum in a finely divided state (platinum-black), of bringing about chemical combination between oxygen and hydrogen gases, or between oxygen and certain hydrocarbon vapours, without the intervention of a flame. The zoo-cautery consists, as shown by the annexed rough sketch, of three principal parts, viz. the handle, forming a benzoline reservoir, the stem, and the head.

The handle (B) is formed of thin metal, spun on a lathe and corrugated, both to afford a better grip and to increase the surface from which evaporation takes place. Its interior is packed with fragments of sponge saturated with benzoline, and through the centre passes a small tube, which conveys a portion of the air, pumped into the apparatus directly towards the stem, without passing through the sponge. At the extreme end of the handle is a nipple, over which is slipped the india-rubber tube of the bellows, and a little two-way stopcock (A), which when turned in a line with the handle allows air to pass freely both through the small (direct) tube mentioned, and also through the mass of sponge in the handle; but when turned at an angle gradually shuts off the stream from the sponge-packed part until at last (at right angles) it admits air alone through the direct tube. By examining the top of the handle before screwing in the stem the small *direct* air-tube will be seen projecting upwards through the mass of sponge.

The stem (C) is merely a strong metallic tube supporting the head, and conveying to it the mixed air and benzoline vapour delivered

from the handle. At its upper part is a clamping nut, by means of which the head can be set in a line with, or at any angle to, the stem.

The head consists of a hollow nickel shell carrying at its extremity the cauterising surface or point, made of platinum-iridium alloy, and lined within by fragments of fine platinum gauze to assist the combustion of the vapours. Special attention is directed to the screw (D) shown on each of the heads, as it plays an important part in the working of the apparatus.

To start the cautery in action, the stem is first unscrewed, and benzoline poured into the handle from the upper end until it overflows. The handle is then inverted, and all excess of benzoline allowed to flow away, leaving the sponge saturated. The parts are then screwed together, the bellows affixed and started, the little two-way stopcock (A) at the bottom turned nearly at right angles, the small screw (D) *in the head* opened as far as possible, and a light applied to the holes shown in the head. If all is acting properly, a strong bluish flame will be seen within the head, and a rather loud hissing sound will be heard. If not, the bottom stopcock is turned one way or the other, so as to alter the proportions of air and benzoline vapour passing to the head, until the flame appears and burns steadily. In a minute or two the entire head will become strongly heated, and if the top screw (in the head) be then turned home, the blue flame will disappear, the hissing noise will cease, and the point of the cautery, previously quite dull, will suddenly begin to glow, and soon attain a bright reddish-white heat. The reason of this is that the direct flame is extinguished, and the vapours are caused to burn *within*

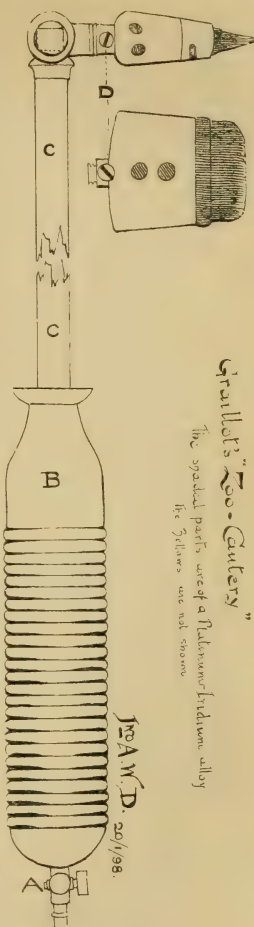


FIG. 215.—The zoo-cautery.

the *platinum point* or head. The instrument is now ready for use, and will continue acting for twenty minutes to half an hour by simply

working the bellows. Should the heat decline, a slight turn of the lower stop-cock will admit more benzoline vapour and restore the required temperature. If employed in the open air some precaution is required when starting to shield it from draughts. A point of considerable importance is to obtain the right kind of benzoline; the common benzoline sold in oil-shops for use in cabmen's lamps or in the little cheap night lamps seems to answer best.

The second instrument shown (Fig. 216) is quite different in principle from that of Paquelin, and has the great advantage of being automatic in action when once started, and of requiring no bellows. Every one has probably seen the flaring, roaring lamps used in carrying on railway works, large building operations, etc., at night; the roaring noise and the intense light distinguish them from others. Déchery's cautery is a modified reproduction of one of these. It may be divided into reservoir (AA), vapour-chamber (B), and burner. The illustration shows these, the essential portions of the interior being indicated by dotted lines.

To resist the considerable pressure at which it works, the instrument is strongly made of nickelled brass. The reservoir is shut off from the vapourising chamber by a conical

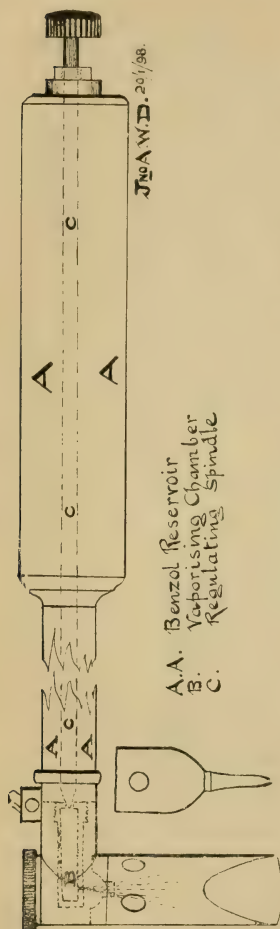


FIG. 216.

Déchery's automatic cautery. The dotted lines indicate the position of essential portions of the interior.

valve, worked by means of a long spindle (C) carrying at its extreme end a milled nut. The vaporising chamber consists of a small

brass casting, hollow in the centre, and presenting two apertures—that at the bottom, through which the benzol enters, being closed by the conical end of the spindle; and a second, extremely small one at the side, through which the vapour issues at high pressure. As will be noted (see Fig. 216), this minute stream of high-pressure benzol vapour then rushes through a rather wide tube, inducing in its passage a smart current of air, with which it becomes intimately mixed, and finally burns in the head with a bright blue, smokeless, but intensely hot flame.

To start the apparatus the large bottom nut is unscrewed, and the reservoir filled with *carefully filtered* benzol. (It is important to filter the benzol carefully, as the smallest speck of foreign matter may choke the minute orifice in the vaporising chamber from which the vapour issues.) The parts are then screwed together, the valve spindle turned home, and the head heated in a spirit-lamp flame for two or three minutes. This warms the head and vaporising chamber, and prepares the apparatus for starting. As, however, there is at first no positive pressure within the apparatus, the benzoline would not flow into the vaporising chamber, and it therefore becomes necessary to heat the *stem*, so as to cause the benzoline to expand and to flow out when the valve is opened. The flame is therefore advanced a little, and allowed to play round the top of the stem for a minute or two, when, on opening the valve by turning the milled head with the fingers, a few drops of benzoline are injected into the heated vaporising chamber, are converted into gas, rush out into the head, become mixed with air, and burn into the outer part of the head, as above described. If the apparatus has been sufficiently warmed at the outset it now becomes self-acting, the heat of combustion being conducted to the vapour-chamber and the stem to a sufficient degree to promptly convert the benzol into gas as it issues from the reservoir, and to keep the benzol in the reservoir itself nearly at boiling-point. It may be imagined, however, that the pressure in the apparatus would become dangerous and involve an explosion. Two safeguards are provided against this. Firstly, the apparatus is very strong; and secondly, an undue pressure in it would force benzoline outwards in such quantity as to produce large white flames, and thus give timely notice of danger. In practice the writer has found the apparatus remarkably steady and reliable. The firing points and edges are easily heated to a bright cherry red, and the apparatus works without any regulating for twenty minutes to half an hour, when a turn of the milled head will enable one to

continue for another quarter of an hour, a sufficient period to finish an ordinary operation.

As the whole apparatus would otherwise become unpleasantly warm, the main body of the reservoir is covered with a tube of insulating material,—“vulcanised fibre.” The fact that the expensive platinum heads and points are entirely dispensed with permits of the apparatus being sold at a very reasonable sum.

For heating the ordinary iron a forge or small stove is usually employed. Charcoal or coke is preferable to coal. Within recent years, however, advantage has been taken of the numerous automatic lamps, burning petroleum spirit or benzole, to produce a convenient and easily transported stove. In these lamps the pressure produced within the body of the lamp by warming the fluid, causes a small quantity to mount through a capillary tube into a chamber surrounding the flame, which chamber is therefore always at a high temperature. Arrived here the liquid is rapidly transformed into gas, and escaping through a small hole, emerges in the form of a powerful jet which sucks air through orifices surrounding it, and when ignited burns with a very intense flame. By adapting to such a lamp a suitable hood for receiving the heads of the firing irons an excellent portable furnace is produced.

A very good form of automatic petroleum furnace is that shown in Fig. 217. The reservoir (*a*) contains ordinary petroleum oil, with which it is filled through the plug (*b*). To set the apparatus in action, the small air-pump (*c*) is worked for a minute or two, until the air pressure in the reservoir is sufficient to force the oil up to the burner (*f*). A little methylated spirit is then poured into the ring at the base of the burner and ignited, thus heating the burner. On then cautiously relaxing the screw (*C*), a fine stream of petroleum flows into the burner, becomes vaporised, and issues as a powerful jet from a small orifice at the base of the tube (*f*), shown as a dotted line. This jet aspirates strong currents of air through the holes in the burner, mixes with this air, and burns with an intensely hot blue flame within the hood (*g*).

Whatever the method of firing adopted, certain general principles must be observed. The preparation of the animal is important. If casting is necessary it should preferably be done on an empty stomach; if the animal is very vigorous and plethoric, the food allowance should be reduced during the previous days, and laxatives must be administered. The point of operation must be thoroughly cleansed, and the hair cut either with a machine or with scissors, but in deep firing, involving synovial membranes, antiseptic pre-

cautions are necessary. The cleaner the skin the less the danger of after-infection. For this reason, when firing in deep points, the writer usually applies over the whole area of operation a dressing wetted with 5 per cent. carbolic solution, which is allowed to remain in position for twenty-four hours, and to become dry by evaporation. It is removed immediately before operation, and is afterwards replaced by a dry dressing of boric acid and surgical cotton wool supported by a bandage. Where the points are less deeply introduced it suffices to smear the parts freely with boro-glyceride after operation, omitting the cotton wool, etc. No blister is used. In applying the iron to certain regions where the skin is very mobile, it is well, if casting is necessary, to mark the outlines of the surfaces to be fired beforehand. Quiet horses are usually fired in a standing position, a twitch being applied to the nose, and the foot lifted to prevent accident. In more extensive operations the parts may be rendered insensitive by subcutaneous injection of cocaine, or by the application of an elastic bandage or cord.

The most convenient apparatus for controlling animals when being fired is undoubtedly the operating table previously described. Firing, however, is often necessary when no such table is at hand and the animal

must be put down. In operating on the external surface of a limb, the horse is cast on the opposite side. If the application is made around a joint, the animal should be cast on the diseased side and the inner face of the limb first operated on. In firing two limbs, the external surface of the one limb and the internal of the other are first completed, and when turning the animal over provision must be made against the cauterised surfaces being soiled or bruised.

Various manœuvres are sometimes necessary. As a rule the limb to be fired is left in the hobbles, while the opposite limb is

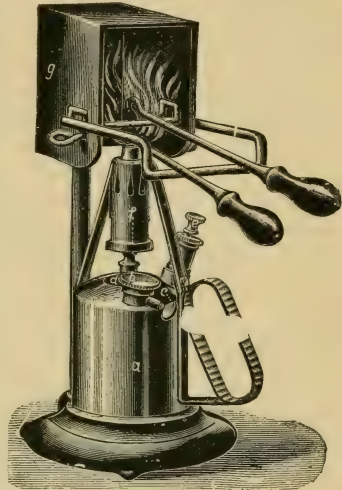


FIG. 217.—Automatic petroleum furnace and protecting hood for heating firing irons.

released and carried either backward or forward. When the pastern or coronet is to be fired, the two limbs can be fastened together above the knee or hock respectively, the diseased limb being released from the hobble and drawn forward or backward by an assistant using a broad strip of webbing.

In line firing, the important point is to trace equally spaced straight lines, extending beyond the diseased region. Converging lines should never cross or unite, the points of crossing being very liable to slough (see Fig. 218). The spaces between the lines vary according to the thickness of the skin and the extent of the cauterised region. Closely placed superficial lines are preferable to others more distant and more deeply penetrating. As a rule a space from three eighths to three fourths of an inch should divide the lines. In France the custom is first to lightly mark out the design, and afterwards to pass the cautery over the lines a number of times. The iron is used at a dull or bright red, the latter being the maximum temperature allowed, and is passed slowly along the marked-out design without pressure, the blade being always kept perpendicular to the surface. The iron should never be passed twice in immediate succession along the same line, and if the French method be adopted, the lines must be retraced in regular order, otherwise sloughing is apt to occur.



FIG. 218.—Pattern for line firing. The lines do not meet.

The operator judges when the cauterising action is sufficient by the appearance of the base of the lines, the exudation which has occurred, the infiltration of the skin, and the degree of separation shown by the epidermis. Judged by these standards, three degrees of cauterisation may be distinguished. In the first the lines are shallow and contain a few little drops of serosity. Their base is of a golden yellow, the skin is little infiltrated, and the epidermis is still adherent. In the second the lines are deeper, their base yellowish brown, exudation is more marked, and the epidermis is loosened. In the third the epidermis is almost cut through, the margins of the lines tend to gape and produce irregular edges, the serous discharge from their base is abundant, and the skin is often covered with vesicles. In the French system the iron is heated to a cherry red, and is passed along each line five or six times in light firing, eight to ten in ordinary firing, and twelve to fifteen in severe firing. It is clear, however, that the number of passages must vary with the weight and temperature of the cautery, the judgment of the operator, and the thickness of the skin.

Superficial puncture or bud firing can often be performed in the standing position. The points should form a regular figure, those of one line corresponding to those of others adjacent. As a rule the points are separated by intervals of three eighths to an inch, though they may be massed a little more closely where the most intense action is required. Here again the French prefer to apply the iron a number of times to the spots *seriatim*. The completion of the process is judged of by the same indications as in line firing. In England, however, it is unusual to apply the iron more than once, or at the most twice, a method which appears to be perfectly successful, and when combined with the after-application of a blister, to have the advantage of leaving less mark than the French method.

In deep point or needle firing the cautery passes completely through the skin and subcutaneous connective tissue into the diseased part. The points must be disposed regularly, and at equal distances, though they may be placed rather more closely together than when firing the skin alone. With gentle pressure the cautery rapidly perforates the skin. This method has the advantage of being easy and rapid to carry out, and of producing a more intense and deeper action than that previously considered. The iron should never be applied more than twice. A light blister may be applied a few days after operation.

Until comparatively recent times the danger of penetrating synovial sheaths, etc., was regarded as excessive, and although a few practitioners like Basch, Fischer, and Robertson recommended puncture with fine pointed irons, the method was never extensively accepted, and when practised not infrequently led to disaster. In 1867 Bianchi recommended puncture of dropsical synovial sheaths with the red-hot needle, a system which, after long discussion and some modification, is now becoming more and more popular. Even if carefully practised it is not without danger, especially for articular cavities, but considering the intensity of its action and its therapeutic value it constitutes a great advance on older methods. The point, however, must be extremely fine, those usually employed not exceeding one twenty-fourth to one sixteenth of an inch in thickness. When of iron these are difficult to make and to keep in order; platinum points like those supplied with the zoo-cautery are preferable. The punctures are best made in a regular design at intervals of about an inch. The method of procedure is important: the needle, at a red heat, is sharply thrust to the required depth, and immediately withdrawn. There is no disadvantage in passing the needle more than once into fibrous or osseous tissues,—indeed, this is necessary to produce intense

effects; but in dealing with synovial membranes the passage of even a fine needle more than once is dangerous. On the other hand, no bad results need be feared from penetrating a synovial sheath, provided the puncture be made with a single application. The minute channels are aseptic when made with a red-hot instrument, and provided the needle be sufficiently fine, and the operation completed with one movement, they remain so. It is not necessary, however, in dealing with dropsical synovial sheaths that all the points should penetrate the sac; as a rule one actual puncture is sufficient. In other tissues two or three punctures may be made. In certain cases the operation may be followed by the application of a blister.

The emollient dressings formerly employed after firing appear in the light of later experience to be contra-indicated, as they favour suppuration, retard healing, and tend to increase the area of the wounds and of the subsequent cicatrices. They should certainly not be employed immediately after operation. When the inflammation of the skin after firing is intense, antiseptic lotions or powders may be employed. If, on the other hand, the reaction is insufficient, a blister of biniodide of mercury, or cantharides may be applied immediately or within a day or two after firing. In thoroughbreds and other horses with a fine skin the application of a blister to the fired surface should be deferred until the wounds made by the cautery have healed and the local swelling has disappeared. For these animals the blister should be about half the strength of that applied to draught horses.

The results of firing vary greatly according to the method employed. A day after superficial firing considerable swelling and more or less abundant exudation especially from the lines or points, will be observed. The liquid dries, forming yellowish-grey crusts, covering the whole region. The horse has pain in moving, shows marked lameness and intense local irritation. As long as these continue the horse must be closely watched, and care taken to prevent the parts being bitten, scratched or rubbed against neighbouring objects. The best method is to tie the animal to the pillar reins, or to a ring above the manger, apply a cradle to the neck, and dust the fired surface with a mixture of boric acid, zinc oxide and kaolin. The crusts become loose towards the eighth, tenth, or fifteenth day; to assist separation the parts may be bathed with warm water, or preferably dressed with an antiseptic ointment.

If the skin tends to crack, the parts are covered with boric vaseline or glycerine. At a later stage the scabs produced by the cautery disappear. When extending deeply and implicating the

whole thickness of the skin they are sometimes very adherent, and only separate after a suppurative inflammation, leaving exuberant granulations, which are followed by indelible scars, the covering of hair never being restored.

While these processes are going on at the surface the subcutaneous tissues have become hyperæmic and inflamed, infiltrated with an abundant exudate, and the seat of active cellular proliferation. This condition is later followed by resorption, consolidation, and compression, results to which the beneficial action of firing is often attributed.

The effects of deep point firing are still more marked. The limb often becomes greatly enlarged, although a free serous discharge occurs through the skin. The small, closely-packed cicatrices in the skin and cellular tissue resulting from such firing form a kind of permanent compress which is much superior to bandages. It is certain that the retraction of these islands of new tissue exerts on the diseased part an active compression resembling that produced by an elastic bandage. The treatment of the patient differs in no essential respect from that required after superficial firing. The symptoms shown after deep needle firing depend on the depth of penetration and the nature of the tissues involved. Active inflammation always results in the region cauterised. The limb becomes greatly swollen, sometimes very hot and painful, while the animal shows more or less marked fever. Moreover, when a synovial sac has been opened synovia is discharged, sometimes in large quantities, forming a yellowish-grey albuminous layer, which may even flow downwards over the foot or reach the ground.

At the end of two or three days this synovial discharge hardens, the apertures become obliterated, and the discharge ceases. The crusts separate during the second week; the scars begin to disappear towards the twentieth day, leaving in their place little reddish cicatrices. Swelling of the parts sometimes persists for a long time, but can be diminished by exercise and massage. The hair rapidly grows again, and almost entirely masks the little smooth cicatrices left by the cautery. This is one of the chief advantages of the method.

Whatever the degree of firing or the mode employed, a certain period of rest is requisite to permit of the gradual subsidence of inflammation and its effects. As a rule, after the lapse of the second or third week following operation it is well to walk the patient daily for ten to twenty minutes. When the fired surface has recovered from the action of the blister, the animal may be sent to grass, or

rested in a strawyard for two or three months. In injuries to the tendons, in spavin lameness, and some other conditions such rest is absolutely essential.

The operation may be complicated in various ways. Thus the skin may be divided and a gaping wound produced; capillary hæmorrhage may result, or the fired surfaces may be torn. Such results may, however, be avoided by reasonable care. Loss of skin and the formation of large cicatrices following too severe a use of the iron are more serious. When such results threaten means must at once be taken to prevent sloughing. The frequent application of the cold spray is one of the most common methods; if conjoined with an antiseptic lotion it is more useful, it cleanses the parts, and removes the irritating exudate which aggravates the inflammatory symptoms. Lotions, astringent compresses moistened with weak acetate of lead, or alum solution, and a paste, made with calamine and boiled water, have also been recommended. Lukewarm antiseptic baths followed by dusting with iodoform or a mixture of iodoform and tannin are preferable. Nocard highly recommends spraying with an ethereal solution of iodoform. He says that it abolishes suppuration, and checks the microbic infection of the wounds resulting from the removal of the scabs. Hæmorrhage resulting from puncture of a vein or arteriole by the needle is without danger. It either ceases spontaneously, or can be stopped by a tampon of wadding, or by applying a compress powdered with iodoform.

Subcutaneous cauterisation, recommended in Italy, appears to present no marked advantages, and may be dismissed here with the statement that the skin is first divided, the edges held apart, and the globular-headed iron applied directly to the deep-seated structures thus exposed.

In times past it was not unusual to fire sound horses with the idea of preventing the formation of ring-bones, spavins, etc. Needless to say, such a course is not only inhuman but absolutely useless.

XII.—SETONING.

FORMERLY setons were frequently used as counter-irritants in the treatment of muscular atrophy, lameness of the hip or shoulder, spavin, and navicular disease. In current practice setons are mainly employed to establish drainage of abscess cavities, sinuses, and lacerated wounds in process of healing. As, however, many practitioners have faith in the value of setoning in the treatment

of chronic lameness and some other conditions, a diagram is furnished below showing the various positions in which setons may be inserted. Setons are inserted with a special needle (Fig. 220), from eight to sixteen inches in length, and usually made of steel or soft iron. The point, sharp or blunt, is spatulate and of steel, the body is usually flattened and often divided into two parts, which can be screwed together. The eye is sometimes at one end, sometimes at the other. For the purpose of passing frog setons Sewell invented a special needle (Fig. 220A). For operating on hæmatomata, etc., the needle shown in Fig. 220B is used. It consists of two cylindrical portions (about three sixteenths of an inch in thickness),

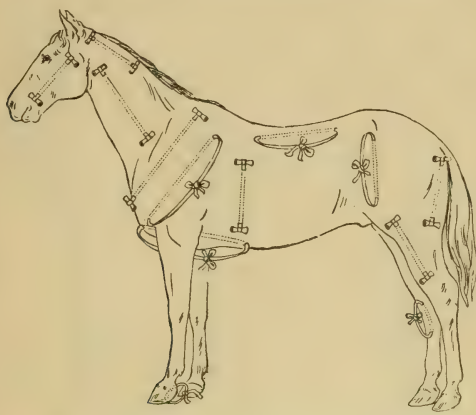


FIG. 219. Schema showing positions in which setons may be inserted.

which can be screwed together. The point resembles a three-sided pyramid.

Should the animal prove very troublesome it may require to be cast before a seton can be inserted, but as a rule it is sufficient to apply a twitch and lift one of the fore-feet. Generally, it is best to pass the needle from below upwards, as should the animal struggle it is more easily withdrawn, while it is less likely to go astray. Should it be inserted in the opposite direction and an error be made necessitating change of direction, a pocket is left in which pus may accumulate.

Views differ as to the depth to which setons should be inserted. Some prefer the subcutaneous tissue, others penetrate beneath the panniculus. The latter method, however, is sometimes followed by

troublesome extension of the suppurative process, and is not to be recommended.

Having selected the lowest point, the skin is raised in a fold and either divided with rowelling scissors (Fig. 221) or with a knife. The

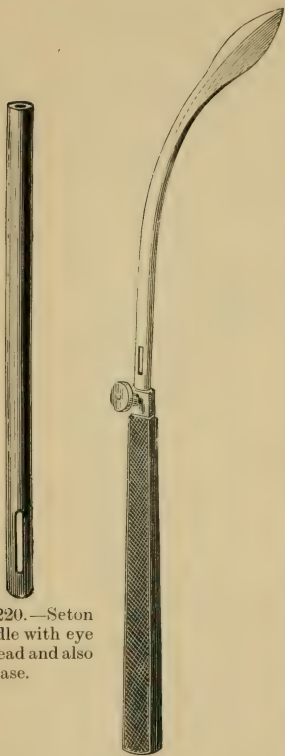


FIG. 220.—Seton needle with eye in head and also at base.

FIG. 220A.



FIG. 220B.

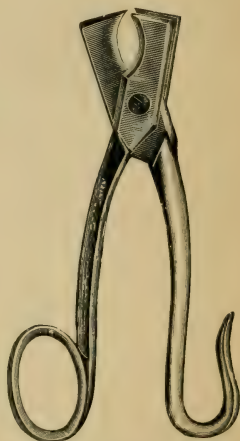


FIG. 221.—Rowelling scissors, for making the preparatory incision when inserting seton.

point of the needle is then introduced, with its flat side towards the skin, and the needle thrust forward, its course being carefully noted, and if necessary controlled by the fingers of the left hand. The needle used in France possesses a sharp point, and therefore readily penetrates the skin at the end of its course; but with the common English needle it is necessary to make an incision for exit. The

point of the needle is then grasped with fingers or forceps and withdrawn through the upper orifice, bringing with it the tape with which it has been threaded. If, however, the eye is in the point of the needle the tape is not inserted until the eye appears through the upper wound. The tape is then passed and the needle withdrawn, leaving the tape in position. The tape, which must be at least twice as long as the seton track, is secured by firmly tying the ends together or by attaching each end to a transverse piece of rubber tube. The disadvantage of uniting the ends consists in the danger of the loop so formed catching on a hook or other object or being grasped in the horse's teeth, and the seton being torn out. To prevent this the horse should be tied up or a side-stick applied. In dogs a muzzle must be put on.

To increase the action the seton is smeared with an irritant, and is daily moved to and fro. As soon as pus forms, free drainage should be secured by fomenting the orifices daily and gently stroking the channel from above downwards. The seton may be left in position from eight to twenty-one days. To remove it the upper end is snipped off with scissors and the tape drawn downwards. If left too long in position ulceration and sloughing of the skin over the seton may be produced.

Inserting a frog seton demands certain special precautions. The horn around the point of the frog having been thoroughly thinned, an incision is made above the bulbs of the heel, and the special needle, with its convex side towards the tendons, is thrust downwards through the plantar cushion towards the point of the frog, the foot meanwhile being extended as far as possible. The needle should appear near the point of the frog. The ends of the tape are knotted together and a dressing applied.

In passing setons, blood vessels may be wounded, but as only small twigs are usually affected no special precautions are called for. Where nerves are injured paralysis may result, and in some cases tendon sheaths and joints have been opened. The passage of a seton under fasciæ, or the panniculus may be followed by extensive suppuration, with abscess formation at some distance from the seton. Occasionally, and especially during summer, infection of the seton track occurs with extensive inflammatory œdema—which may lead to a fatal result. After removal of the seton, the wounds may granulate excessively, producing considerable deformity of the part; in that event the wounds should be treated by compression, dried alum, or the actual cautery.

XIII.—INOCULATION.

By inoculation is meant the intentional conveyance of infectious material to a healthy subject. A wider meaning is sometimes attached to the term, causing it to extend to the products of micro-organisms such as antitetanic and antidiphtheritic sera, mallein, etc. Inoculation is a most important process in studying the life history of bacteria, their nature, virulence, mode of action, etc. Animals, again, are inoculated to protect them against certain diseases, like black-quarter, anthrax, and swine erysipelas (*rouget du porc*), to produce new (modified) infective material (vaccine), and finally, though not very often, to shorten the duration of epizootic disease. Various forms of needle have been used for inoculations. The oldest is Sick's (Fig. 222). A furrow in the middle of the head holds the infective material. Sticker employed a special needle (Fig. 224) for pleuropneumonia inoculations. The needle was thrust under the skin, and the virus injected by pressing on the button at the side of the handle. Fig. 223 represents Pessina's needle. In use the furrow is filled with virus, the needle thrust into or under the skin, revolved and withdrawn, leaving the infective material within the wound.

At present, sterilisable syringes are almost universally employed for protective inoculation, as well as for the injection of mallein and tuberculin for diagnostic purposes; an operation which is closely akin to inoculation, and is carried out in a similar way. As a rule the stem of the piston carries a movable stop which can be fixed at a prearranged point, allowing only the exact amount of material

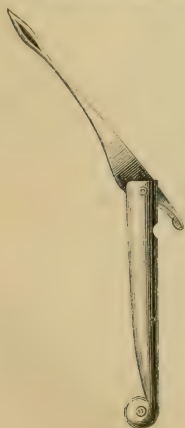


FIG. 222.

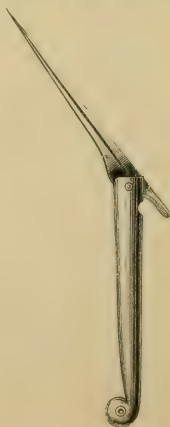


FIG. 223.



FIG. 224.

to be injected at each operation. Such syringes are now made with asbestos or metal plungers, and can be taken to pieces, or are of such a nature as not to be injured by boiling or otherwise sterilising.

Before making the injection the point of operation should be shaved and thoroughly disinfected. Care must be taken, except in

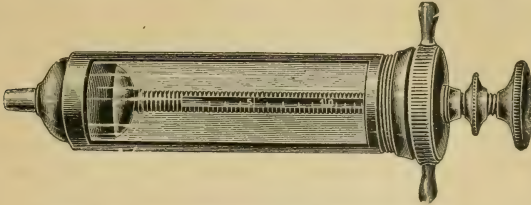


FIG. 225.—Sterilisable syringe ; ready for use.

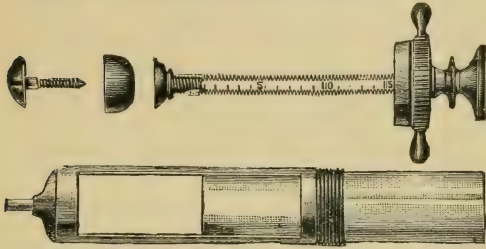


FIG. 226.—Sterilisable syringe ; dismantled.

endemic inoculation, that the fluid really penetrates beneath the skin and not into it or into the muscular tissue, as often happens. Neglect of these precautions, or failure thoroughly to sterilise the instruments, explains most of the cases of abscess formation, and other exceptional complications after inoculation. The best plan is to raise a fold of skin with the left thumb and fore-finger and rapidly thrust the needle through the skin in the length of the fold. The fluid is spread over a larger surface by gently manipulating the parts after removing the needle.



FIG. 227.—Roux's sterilisable syringe without piston.

After injection the syringe and needle must be thoroughly washed and sterilised.

As a rule no special restraint is needed, as the pain is very trifling. In large vaccine institutes the smaller animals are usually secured on movable operating tables.

XIV.—THE INJECTION OF MEDICINES INTO THE BLOOD-STREAM, SUBCUTANEOUS TISSUE, TRACHEA, PHARYNX, LARYNX, OR PARENCHYMA OF ORGANS OR TISSUES.

(a) INTRAVENOUS injection. In former times bleeding was often a preliminary to intravenous injection of medicines. In horses, for instance, the jugular vein was opened with the fleam, and the medicine injected by means of a funnel and tube. Apart from the danger of thus introducing air into the vein phlebitis often followed. At the present time a fine trocar and cannula, or a syringe with a hollow needle is used for intravenous injection. In horses and cattle the jugular vein, and in dogs the saphena vein are the vessels selected for the introduction of remedies into the circulation. The number of materials fitted for intravenous infection is limited to a few alkaloids, antitoxins, normal saline solution (.9 per cent.), barium chloride, silver colloid, chloral hydrate, etc. The intravenous method has the advantage of producing immediate effects, while subcutaneous injections require at least four or five minutes, but this advantage is more than offset by the time required to prepare the solution and the seat of operation previous to intravenous injection. The fluid for injection must be diluted, non-irritant, and aseptic.

Injection with the ordinary syringe is carried out as follows :—After disinfecting the skin at the seat of injection, the operator grasps the shaft of the hollow needle between the index and middle fingers of the right hand, the thumb resting on the broad expanded base. The right jugular vein is compressed with the thumb of the left hand and the needle thrust obliquely downwards through the skin covering the most prominent part of the swollen vein at the spot usually chosen for bleeding. As the animal is often restless at this stage the right hand is simply pressed against the neck without for the moment attempting to introduce the needle further. As soon as it becomes quiet the needle is sharply thrust a little further in the same direction. If the attempt has been successful blood will flow from the open end of the needle when the thumb is removed, showing that it has entered the vessel ; otherwise another trial must be made. The needle is introduced as close as possible to the point compressed by the thumb, as the vein is partially fixed there and is less likely to evade the needle. Once introduced into the vein the needle should be moved as little as possible to prevent injuring the intima. Having satisfied himself that the syringe contains no air, the operator then affixes it to the needle and steadily injects the contained fluid into the vein.

The double-acting syringe is employed in a similar way. One nozzle is connected by a rubber tube with the needle inserted in the vein, the other by a similar tube with the vessel containing the injection fluid. After injecting the contents of the syringe into the vein the two-way tap is turned and the barrel of the syringe again filled by drawing back the piston. By returning the tap to its original position and once more pressing down the piston a second quantity is injected; the process can be repeated as often as desired.

One of the drawbacks of intravenous injection is the tendency to thrombosis of the vein in consequence of injury to the tunica intima by the needle. This danger, however, as well as that of the entrance of air, can be avoided by skilful manipulation. By proper care in choosing the drug and carrying out the above manipulation bad results are avoided.

(b) In subcutaneous or hypodermic injection, which has largely replaced the above method, the drug is injected by means of a syringe and hollow needle into the loose connective tissue beneath the skin. A graduated syringe holding about 2 to 4 fluid drachms is used and the injection made at a spot clear of the harness and where the skin is freely movable, *i.e.* where subcutaneous tissue is abundant. The side of the neck, breast, behind the elbow, and flank are convenient positions.

By this method various alkaloids, sera, vaccines, mallein and tuberculin are administered. Hypodermic solutions should be sterile and non-irritant. The syringe and needle should be thoroughly clean and sterilised by boiling or by washing with 5 per cent. carbolic solution. This precaution is doubly necessary when the syringe has been previously used for animals suffering from contagious disease.

The seat of operation should always be disinfected before injection. Raising a fold of skin with the thumb and index finger of the left hand the operator passes the needle along the fold or at right angles to it into the subcutaneous tissue. When, as occasionally happens, a blood-vessel is punctured, as shown by the escape of a few drops of blood, the needle should be partly withdrawn, and if the bleeding



FIG. 228.—Double-acting syringe.

ceases the syringe may then be fitted to the needle, the fluid slowly injected, and the needle withdrawn. By gently stroking the skin, the injection is dispersed over a larger area in order to promote rapid absorption.

(c) Intratracheal injection is practised for the purpose of treating diseases of the upper air-passages like chronic laryngeal or tracheal catarrh, to kill parasites present in the trachea and bronchi, and as a means of combating certain general disorders like purpura hæmorrhagica and hæmoglobinuria. As absorption occurs very rapidly from the tracheal and bronchial mucous membrane this system of medication has a rational basis, but, as a rule, more convenient and less dangerous methods deserve preference. From the experiments made it has become clear that the tracheal mucous membrane is far less sensitive than was formerly imagined, and that irritants like tinctures and oil of turpentine are really very well borne. As, however, the tracheal mucous membrane cannot be disinfected the small punctured wound may not heal aseptically, and although in healthy animals there is little danger, yet, should inflammatory action set in, as may readily occur in purpura, serious consequences may follow. Recent experience shows that necrosis of the tracheal mucous membrane, and even of the lungs, sometimes occurs. The needle must be cautiously inserted, and as it is sometimes subject to considerable stress it should be stout in order to avoid breakage. In the event of this occurring the broken fragment must at once be grasped with forceps, or, if it be invisible, a cutaneous incision must be made in order to detect and remove it.

Intratracheal injections may be made with an ordinary hypodermic syringe provided with a stout needle, with a large Pravaz syringe, or with Dieckerhoff's syringe, which is used in conjunction with a special trocar and cannula. The animal's head is raised, and the operator, stretching the skin covering the front of the trachea with the fingers of the left hand, thrusts the needle or trocar through the space between two tracheal rings. Removing the stilette he inserts the nozzle of the ready-filled syringe in the mouth of the cannula, and slowly injects the contents into the trachea.

Dieckerhoff also recommends intralaryngeal and intrapharyngeal injections. The method is similar to that above described. A curved needle, with its convexity directed upwards, is passed between the cricoid cartilage and the first ring of the trachea, traversing the crico-tracheal ligament, and fluid is thus injected into the larynx or pharynx. In chronic laryngitis Dieckerhoff

recommends subnitrate of bismuth or 1 per cent. iodine solution (Lugol's solution) repeated every few days.

(d) Parenchymatous injection consists in introducing solutions of drugs into the parenchyma of organs, like the thyroid or lymphatic glands, or into muscles or pathological new growths. The active agents are thus brought into immediate contact with the affected tissues. In veterinary surgery actinomycotic growths are the commonest objects of such treatment, though tumours and the swellings of goitre have also been injected, but with varying results.

Solutions of acetic, carbolic, or lactic acid, iodine, zinc chloride, strychnine, nuclein, papain, etc., have all been used for parenchymatous injection. In the hands of several operators iodine and papain have given good results when employed against soft new growths and goitre.

A rather stout needle is inserted—if possible, into the centre of the organ or growth (sometimes a specially long needle is required), and the solution injected. A few drops are often sufficient. Slight pressure should be kept on the piston during withdrawal. Sometimes several injections are made at different points. The operator judges of the need for repeating the operation by the condition of the diseased parts, and by the reaction which follows. As a rule one should wait until all signs of the previous treatment have disappeared.

The principle of parenchymatous injection is not new, for a somewhat similar process, viz., the introduction of solid caustics, like arsenic and sublimate, has been in use since very early times.

XV.—CASTRATION.

FOR economic reasons, the removal of the testicles or ovaries, or the destruction of their functions, often becomes necessary. The gelding is, for most purposes, more useful than the stallion; its conformation is modified, it is usually more tractable, and it can be worked in company with mares, a proceeding which is seldom safe in the case of stallions. The flesh of pigs and birds becomes more palatable, and animals fatten more readily after castration. Sheep fatten more quickly, and their wool becomes finer and more abundant. The milking period is prolonged in the castrated cow, and the danger of unsuitable animals breeding is removed. Dogs

are less liable to stray, and bitches cease to attract strange dogs. Finally, certain diseases of the generative organs are sometimes cured by operation. Thus in man castration has been employed for the reduction of enlarged prostate, and in the dog operation for the same object was suggested by Dr. Clarke (see "Veterinarian," 1895). The pathological enlargement of the gland gradually diminishes. In man osteomalacia is said to have been beneficially affected by castration, but how far the procedure is likely to succeed in animals remains to be proved. On the other hand, "spaying" in cows often removes nymphomania; and unilateral oöphorectomy, removing the cystic ovary, has been successful in sterility. Castration is also indicated by the presence of malignant tumours and fistulæ, in certain injuries of the testicles, and in scrotal hernia.

Castration seems to have been performed on animals since the earliest times, and is still an exceedingly common operation. Owing to the essentially different methods of procedure in male and female animals, castration will be treated of separately in each sex.

Castration of Male Animals. Experience shows that male animals are best castrated young. Many of the advantages claimed for operation, such as the change in bodily form, are lost when it is too long deferred.

Excluding the first few weeks of life, most domesticated animals undergo operation during the first year. The horse is an exception, because in it the testicles lie within the inguinal canal during part of the first year, towards the end of which they usually descend into the scrotum, and so become readily accessible. Moreover, horses castrated during the first year often assume a female type, whilst those in which operation is deferred develop to a greater extent.

Anatomy. The testicles are suspended in the scrotum by means of the testicular cords. The scrotum and the structures it encloses may be divided from without inwards into the following layers:

1. The outer skin. This is soft and thin, usually hairless, and in the horse black and shining; it is very extensible, and is directly continuous with the common integument. In ruminants the scrotum shows a distinct neck; the skin covering it is light coloured, and exhibits little hair. In swine the scrotum, which is broad and smooth, lies between the hind quarters, close under the anus; in carnivora it is somewhat lower.

2. Beneath and intimately connected with the skin is the tunica dartos, which consists of a modified subcutis abundantly supplied with unstriated muscular fibres, elastic and white fibrous tissue. Above it is connected with the yellow elastic abdominal tunic, while a mesial prolongation, the septum scroti, serves to divide the scrotum into two equal pouches. Strictly speaking, the skin and tunica dartos together form the scrotum.

3. The spermatic fascia, continuous with the tendon of the external oblique muscle.

4. The cremasteric fascia, continuous with the internal oblique muscle.

5. The infundibuliform fascia, continuous with the transversalis fascia.

6. The tunica vaginalis reflexa, a layer of serous membrane continuous with the peritoneum.

Sir John McFadyean remarks on layers 3, 4 and 5 that the dissector will probably be unable to discriminate between them. These three layers, being more or less adherents, are often referred to as the common vaginal sheath.

The tunica vaginalis reflexa is sack-like in form; above, where it lies in the inguinal canal, it is much narrower than below, where it surrounds the testicle. Its narrowest point is rather more than an inch below the inner inguinal ring, thence it gradually dilates as it descends; as a whole its outline resembles that of an hour glass. In the space (vaginal sac) enclosed by this prolongation of the peritoneal tunic are found the testicle and spermatic cord; in the horse the testicle lies horizontally; in ruminants vertically, with the epididymis pointing downwards.

7. The testicular cord is a flattened, elongated, fan-shaped structure, connected at its lower, broader end to the testicle, whilst its upper portion extends into the abdominal cavity. It is invested by the tunica vaginalis propria, a prolongation of the visceral peritoneum, and consists of the vas deferens, spermatic vessels and nerves, and the cremaster muscle.

The vas deferens, which is placed at the posterior part of the spermatic cord, is a thick-walled tube, representing the excretory duct of the testicle, in large animals of the size of a goose-quill, surrounded by a fold of peritoneum and situated on the inner side of the spermatic cord; by its convolutions it forms the epididymis, the anterior enlargement of which is termed the *globus major* on account of its greater size, the posterior the *globus minor*: the intermediate part is called the *body*. The vas deferens enters the abdominal cavity through the inguinal canal, passes backwards, surrounded by a special fold of peritoneum, towards the upper surface of the urinary bladder and empties by the ejaculatory duct into the urethra.

The spermatic artery lies in the front part of the spermatic cord and is accompanied by the artery of the cord, and the large and tortuous spermatic veins, the convolutions of which form the plexus pampiniformis. The anterior portion of the cord (the vascular portion) therefore contains the important blood-vessels, whilst the posterior is comparatively poor in vessels, a point of great importance in connection with castration.

The inguinal canal consists of a flattened, funnel-shaped space between the abdominal coats, communicating above through the medium of the inner abdominal ring with the peritoneal cavity, and below by the outer abdominal ring with the interior of the scrotum. The outer abdominal ring, an oval opening between the inner and outer limbs of the tendon of the external oblique abdominal muscle, can be enlarged by drawing back the hind limb of the corresponding side. The ring can then be felt by passing the hand gently upwards along the inner surface of the thigh and some estimate of its size can be made, a matter of importance under certain circumstances.

In the horse the inner abdominal ring is an opening about $\frac{3}{4}$ inch to $1\frac{1}{2}$ inches long, between the posterior border of the inner oblique muscle

and the reflected portion of the external oblique tendon, *i.e.* Poupart's ligament; it lies just in front of the transverse portion of the os pubis, inclined obliquely forwards and outwards; $\frac{3}{4}$ inch nearer the middle line lies the subcutaneous abdominal artery.

Castration does not necessarily imply removal of the testicles. The function alone of the testicle can be destroyed, but as the process is necessarily less certain than that in which the testicles are removed, the latter is very generally preferred. No description of the subject, however, could reasonably be regarded as complete which omitted reference to the former method. A short description will first be given of

I. CASTRATION WITHOUT REMOVAL OF THE TESTICLES.

(a) **Crushing the Testicle.** A method formerly used especially in Spain, consisted in first applying clams to the scrotum and then crushing the testicles singly by blows from a wooden hammer. Apart from the uncertainty of the result, the method was barbarous and painful in the extreme. The same is true of the system of perforating the testicle with a glowing iron.

(b) **Crushing the Spermatic Cord.** The neck of the scrotum was included in wooden clams which were hammered for several minutes with a mallet. The operation was usually performed on calves. When successful, the testicles gradually became atrophied in consequence of thrombosis of the spermatic vessels. Steers were castrated by this method in India. The operation, if it may so be called, was also performed on sheep and goats, the reason of its adoption being the danger in a hot climate of inflicting surgical wounds and the fact that after-treatment is thus dispensed with.

(c) **Torsion of the Spermatic Cord** was formerly much employed in France for bulls, and is known as *bistournage*. The animal's head was fastened up securely and the operator, standing behind the animal, grasped the scrotum in both hands and drew one testicle as far backwards as possible. On releasing the scrotum the testicle was drawn upwards. By repeating this manœuvre several times the cremaster muscle was temporarily paralysed and could no longer retract the testicle.

As soon as this result was attained the spermatic cord was grasped close above the epididymis with the thumb and first and second fingers of the left hand, while with the fingers of the right hand the

testicle was rotated, the lower end being brought to the top. In this position the testicle was grasped with both hands, rotated several times on its long axis, and then thrust into the inguinal canal. The remaining testicle was similarly treated and a ligature applied around the scrotum close to the outer abdominal ring and left in position for forty-eight hours. At first some swelling developed but soon afterwards disappeared, and the testicles underwent atrophy. The original procedure, which in practised hands scarcely required five minutes, has since been repeatedly modified, and has been practised on horses. Morot recommends rotating the testicles from 6 to 9 times in bulls and 9 to 12 times in rams, and then to allow the testicles to resume their natural position; the application of a ligature is unnecessary. The animals are said to show less pain and can at once be returned to pasture. This method, however, requires more exertion and skill on the part of the operator.

(d) **Subcutaneous Ligation of the Spermatic Cord** was first recommended by Martin for bulls, rams, and dogs. It is well adapted for castrating goats provided antiseptic precautions be observed. The animal is placed on its back and its legs are held by two strong assistants; the hair is shaved from either side of the neck of the scrotum and the skin disinfected *secundum artem*. The spermatic cord of one side is then thrust against the outer wall of the scrotum by means of the finger and thumb and a tolerably strong silk thread passed from behind forwards through the neck of the scrotum on the inner side of the spermatic cord by means of a needle about two inches long. The free end of the silk thread is then passed through the eye of an otherwise similar but *blunt*-pointed needle which is returned, first through the point of exit, then through the scrotum on the outer side of the spermatic cord, and lastly through the point of entry. The thread thus forms a loop surrounding the spermatic cord. The two ends are tightly tied together, the loose portions snipped off close above the knot, and the ligature allowed to pass into the scrotum; the little puncture is painted with iodoform collodion. The other spermatic cord is treated in precisely the same way. Provided proper care be taken regarding antiseptics suppuration does not occur and the animal seems to suffer comparatively little. The testicles swell somewhat during the next few days, but atrophy commences in from three to four weeks, and the glands gradually and almost completely disappear. Möller states that ligation is followed by necrosis as he ascertained by experiment. To avoid the use of two needles Schmey invented a needle with the eye near the point and a screw-joint in the centre of the shank. The

silk thread was passed as usual on the inner side of the cord, after which the two portions of the needle, within the scrotum, were unscrewed, the spermatic cord pushed between them, and the needle again united and withdrawn. Failing this needle or even a sharp and a blunt needle, the ligature may be returned by using the blunt end of an ordinary needle, *i.e.* by simply using the needle reversed during the second portion of the operation. Asepsis is not difficult of attainment if properly sterilised silk be used. The ligatures must, however, be drawn very tight, otherwise the operation fails and the activity of the glands still continues.

That sexual impulse is not removed by ligation of the vas deferens alone is shown by the following experiment. One sometimes finds cryptorchids in which the epididymis lies in the inguinal canal while the testicle itself is in the abdomen. In one such case Möller ligatured and snipped off the epididymis without removing the testicle. The passage of semen then ceased but sexual desire remained as before until by a second operation the testicle was removed.

II. CASTRATION BY REMOVAL OF THE TESTICLES.

At the present time the commonest method of castrating horses, bulls, and other male animals is by removing the testicles. The testicles are removed either alone or with portions of the scrotum, though the latter method is only usual in calves and goats, where a ligature is passed round the neck of the scrotum. A running noose, formed of a strong piece of cord, is slipped round the upper part of the scrotum and drawn tight. Provided it be drawn sufficiently tight in the first instance the scrotum and its contents fall away in from eight to fourteen days, otherwise the loop must again be tightened. Wooden or iron clams have been used to replace the ligature. Both methods inflict needless pain and are seldom used except in calves, which, however, also suffer much more from clams or ligatures than from the more surgical method of opening the scrotum. Piot claims to have castrated two thousand bulls in Egypt without loss by using the elastic ligature, which is also valuable in the case of goats. The operation is easy and rapid and involves no loss of blood. The elastic cord is applied in a stretched condition, the ends are tied, and the testicles cut away about an inch below the ligature. Care must be taken to prevent the animals licking or gnawing the ligature which might thus be torn away.

Castration by removal of the testicles is accompanied or followed by various dangers which must be carefully kept in mind when operating. They are :—

(a) Hæmorrhage from the spermatic vessels, which under certain circumstances may prove fatal.

(b) Wound infection, which almost always follows opening of the scrotum and may extend to the abdominal peritoneum, causing fatal peritonitis. In castration, as usually performed, aseptic healing of the wounds is seldom possible and their infection is almost unavoidable, though proper precautions in regard to cleanliness and drainage generally prevent a fatal result from this cause.

(c) In those methods of castration in which the tunica vaginalis reflexa is opened (uncovered operation), some danger of prolapse of bowel or omentum always exists. As a rule, however, such an accident only occurs when the inner abdominal ring is exceptionally large, or when inguinal hernia exists, for which reason the scrotum should always be carefully examined prior to operation.

The various methods of dividing the spermatic cord are :

1. **Tearing away of the Testicles.** This method is still used in the case of calves, lambs, and swine ; after opening the scrotum the testicle is grasped and forcibly torn away. In countries like Russia and Australia, where very large numbers of lambs have to be castrated, the system is still followed ; lay castrators in South Germany also continue its use. Should the central portion of the cord not be firmly held, however, the fold of the peritoneum which surrounds the spermatic vessels within the abdomen is torn across or the divided end of the cord is withdrawn into the abdomen, where it becomes adherent to the peritoneum near the inner abdominal ring ; in either case the bowel may be incarcerated, sometimes with a fatal result ("gut-tie").

2. **Scraping the Cord** is sometimes resorted to in young calves, swine and sheep. After opening the tunica vaginalis, the cord is laid across the left index finger and scraped with a blunt knife until divided. The blood-vessels are thus torn, and bleeding is usually trifling. Dawson and Hurford have successfully employed this method with horses ; the posterior portion of the cord was simply cut through and only the vessels were scraped.

3. **Linear Crushing of the Cord by the Écraseur.** Many English and American practitioners employ the écraseur for castrating stallions and other animals, the chain or loop of the instrument being passed round the covered or uncovered cord, which is slowly crushed and divided. Under the strain the tissues of the cord are more or less intertwisted,

the less resistant coats of the artery being torn and retracted, and a coagulum forms within the vessel.

4. Broad Crushing of the Cord by the Emasculator. In England and the Colonies an instrument known as the emasculator or castrator, of which there are several patterns, is largely employed for the castration of horses and bulls. In action the castrator is rapid, humane, and generally satisfactory, there being little bleeding, and it is equally serviceable for operation in the standing and recumbent positions. The procedure varies with the age of the subject and the condition of the cord. After exposing the testicle, the whole cord may be placed within the grasp of the instrument, or the posterior portion may be severed with the knife, and the castrator applied only to the vascular cord, or the posterior and anterior portions may be crushed separately in the order indicated. The last procedure should be followed in the castration of aged horses, in which the small testicular artery may bleed after section without crushing of the posterior portion of the cord.

5. Torsion of the Cord. Torsion may be practised on the covered or uncovered cord. Torsion of the covered cord should be preferred, as there is less risk of peritoneal infection and prolapse of the bowel. In performing this operation by the uncovered method the posterior portion of the cord may be divided with a knife, and the anterior, containing the blood vessels, is twisted in one direction round its long axis until it ruptures. In horses and bulls, after opening the scrotum and applying a clam or forceps above the epididymis, in order to fix the vascular part, the cord, with the testicle, is removed by rotating the testicle and cord either with a second forceps or with the hands. In horses, Jacoulet opens the scrotum in the middle line by a single incision through the skin and dartos, and then divides the deeper coverings of the testicles by a further incision on each side. In sheep, swine, and carnivora, the spermatic cord is fixed between the thumb and the fore-finger of the left hand, while the testicle is rotated with the right hand; the simplest method, after dividing the cremaster muscle with scissors, being to thrust the index finger of the right hand through the centre of the cord immediately above the epididymis, and using the incision so made as a means of grasping and rotating the cord.

When forceps are used for twisting the cord they should not be applied too near the fixation clam or forceps, a space of $\frac{3}{4}$ to 1 inch being left between the two. The most popular of the older forceps for fixing the spermatic cord are Tögl's which are made of two sizes, one for horses and bulls, and the other for smaller

animals. The original form of Tögl's forceps has been variously modified by different operators. Möller uses smaller forceps provided with longer limbs, which give greater leverage and are



FIG. 230.—Tögl's forceps for holding the spermatic cord.

easier to hold. In France Renault's forceps are most used. In England, Robertson suggested a special form of torsion forceps, which has been adopted by Möller. Some operators use a steel

clam instead of forceps to fix the cord, which must be held securely during torsion.

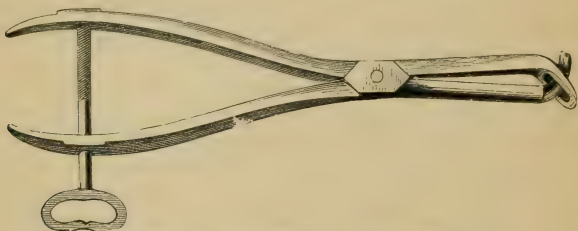


FIG. 231.—Kaiser's forceps for holding the cord.

Most forceps are defective, inasmuch as they take too broad a hold of the spermatic cord, and thus render the effects of torsion

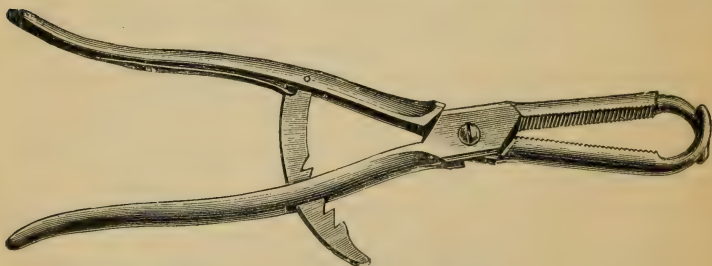


FIG. 232.—Möller's forceps for holding the cord.

irregular. The anterior and posterior margins of the spermatic cord are torn through after the second forceps have been turned once or

twice, and the blood-vessels are divided without having first been sufficiently twisted. Bleeding is then very liable to occur, especially if a second forceps be used for twisting, and if the hold on the spermatic cord be too short. To ensure regular torsion the spermatic cord should first be rolled together into a cylindrical mass, as occurs in using Tögl's forceps. As, however, with Tögl's ordinary

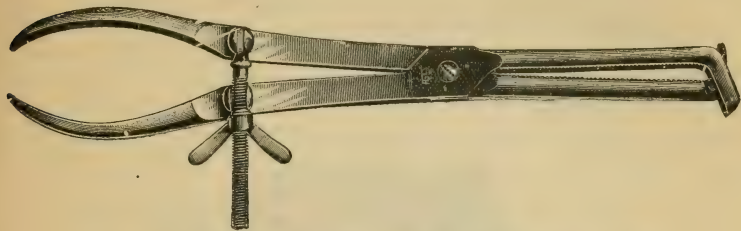


FIG. 233.—Bayer's forceps with screw and instantaneous release, for holding the cord.

forceps it is difficult to compress the spermatic cord sufficiently, the handles have since been much lengthened and the jaws shortened, modifications which have greatly increased their efficiency.

In torsion of the spermatic cord complete closure of the blood-vessels is of prime importance. This can be secured by firmly compressing the portion of cord grasped by the fixation forceps or clam,

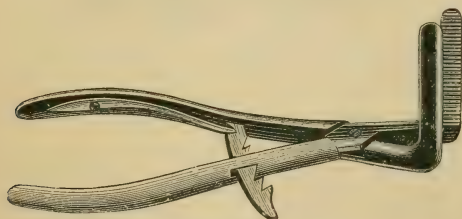


FIG. 234.—Robertson's forceps for torsion of the cord, as adopted by Möller.

and by slowly rotating the torsion forceps. The artery, reduced to a fine thread, is the last portion to rupture, and only yields after prolonged twisting. As a rule fifteen to twenty turns are necessary, sometimes even more. When immediate bleeding occurs it may be due to untwisting of the external coat of the vessel, to its rupture above the twisted portion, or to the force of the blood overcoming

the resistance of the obstruction. Secondary hæmorrhage, which is rare, arises nearly always from infection of the stump.

Another torsion method, though little practised, may be mentioned. It consists of the application to the covered cord of a fixation clam or forceps, section of the cord by the knife about an inch from the clam, and direct torsion of the testicular and cremasteric arteries by means of Assalini's or other artery forceps.

6. **Ligation of the Spermatic Cord** may be practised (1) by transfixing the covered cord in front of the vas deferens with a needle carrying a double thread and ligating separately the anterior and posterior portions; (2) by ligation of the entire cord; (3) by first dividing the nonvascular portion with scissors and then applying

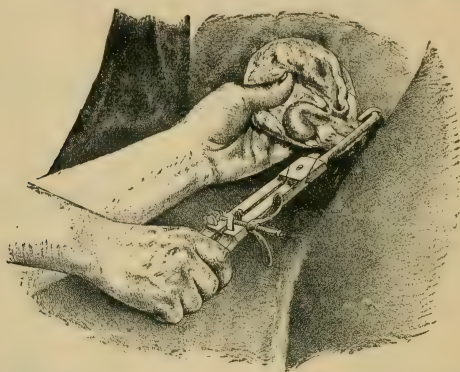


FIG. 235.—Bayer's forceps in use. Many operators prefer Tögl's forceps, which roll the cord together into a cylindrical mass (see text).

a ligature to the anterior portion; or (4) by immediate ligation of the artery after incision of the serous membrane of the uncovered cord. The ligatures—aseptic twist, plaited silk, or chromic gut—having been securely tied and their ends shortened, the cord is divided within half an inch of the ligature. Ligation of the entire cord is serviceable in the castration of bulls and the smaller animals, but in the horse the first procedure, by ligating the cord in two portions, is preferable. There is no danger of the ligatures slipping, bleeding from the artery of the cord is prevented, and the cord being covered there is little risk from post-operative hernia.

Lafosse recommended simple ligation of the spermatic artery. By stretching and flattening out the cord on the index finger of the left hand, and feeling carefully with the thumb the artery may be

recognised as a stout pulsating vessel in the anterior portion of the cord. A needle is passed behind the artery, about $1\frac{1}{4}$ inches to 2 inches above the epididymis, and ligation performed, after which the cord is divided an inch below the ligature. In exposing the artery care must be taken to extend its flexuosities and to apply the ligature at a point which will prevent hæmorrhage after section of the cord. Castration by ligation is the ideal method, but its advantages have not met with the recognition they appear to deserve. Even those operators who first recommended it have given it up. In aseptic castration the ligature has given full satisfaction.

7. **Division of the Spermatic Cord by the Cautery** is one of the oldest methods of castration, and even yet is frequently used in horses and bulls. In practice the testicular cord, covered or uncovered, is held by a fixation clam of wood or steel applied two inches above the epididymis, and the cautery, heated to a bright red, is used to sever the cord within three-fourths of an inch from the clam. After section has been completed the cautery is directly applied to the end of the testicular artery, and if necessary, to the artery of the cord. Hæmostasis is then tested by slightly relaxing the clam, and if bleeding occur the cautery is reapplied. The vessels should be briefly and lightly touched, as prolonged or forced contact of the cautery may remove the eschar. With the object of increasing the thickness of the eschar, powdered resin is sometimes applied to the surface of section and melted with the cautery. No doubt the resin strengthens the eschar and protects the cord, but in effecting hæmostasis by cautery more reliance should be placed on the contraction and inversion of the coats of the artery than on the thickness of the eschar, which mainly serves to support the obstruction within the lumen. Some operators sever the cord with the knife and apply the cautery only to the surface of section, but a more rapid hæmostasis follows section by the cautery. For this purpose the wedge-headed iron, visibly red, but neither glowing nor incandescent, should be held steadily—without sawing movements—with the edge applied across the cord. With the cautery immediate hæmorrhage should not occur, but the cord ought not to be released until pressure applied to the stump produces no oozing from the vessels. Sometimes, as when section of the cord exposes several arterial loops, hæmostasis is difficult, and repeated application of the cautery may be required; and occasionally in aged stallions, owing to the flaccid condition of the vessel or other cause, the cautery fails to arrest bleeding. Secondary hæmorrhage is very rare, though it may occur

in consequence of too early separation of the eschar, infection of the end of the cord, or extensive sloughing brought about by too vigorous application of the cautery. Superficial sloughing of the end of the cord follows light touches of the dull red cautery, but the sloughs are small, generally aseptic, and harmless.



FIG. 236.—Forceps for closing wooden clams.

8. **Castration with Clams** is represented by two methods. In the first a long incision is made through the floor of the scrotum, parallel with the raphe, dividing the skin, tunica dartos, fascial layers, and external vaginal covering, exposing the testicle and spermatic cord. The cord, having been flattened out, is then enclosed in a

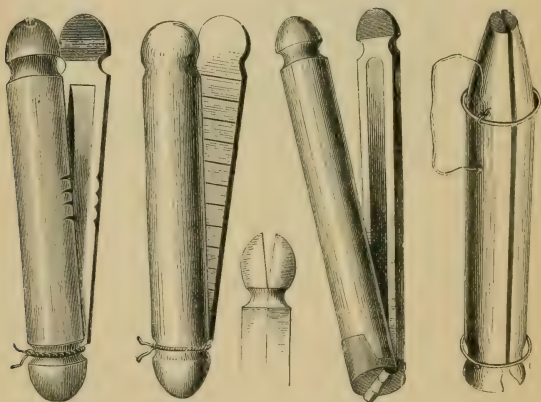


FIG. 237.—Wooden clams.

clam, consisting of two pieces of wood about four to eight inches long, and $\frac{1}{2}$ inch to $\frac{3}{4}$ inch broad, united at one end by means of a cord or hinge. The open ends are brought together with special forceps and secured by tying with strong silk twist or whipcord, or by the application of a leather cap, rubber ring, or brass fastening; and the cord is severed about half an inch from the clams. After

an interval of twenty-four to forty-eight hours or longer the clam is removed.

In the second method, which is known as the "covered operation," the coverings of the testicle—skin, dartos, and fascial layers—outside the tunica vaginalis reflexa (or tunica vaginalis scroti) are carefully divided, and then separated by stripping from the testis and cord as high as may be required. The clam is applied to the cord above the epididymis and over the parietal serous covering (tunica vaginalis reflexa), and secured as above described. The testicle with the lower end of the cord is removed with scissors or a knife; the clam is left in position for twenty-four to forty-eight hours, and in cases of hernia it is advisable to allow the clam to fall off.

The clams should be made of hard, tough, light wood (elm, boxwood, oak, ash, or hickory), and their edges should be well rounded to prevent injury to the surface of the cord. The internal or pressure surfaces may be flat or grooved, and either undressed, or medicated with caustic or anti-septic pomade, containing copper sulphate, arsenious oxide, zinc chloride, or corrosive sublimate. Sometimes the pressure surfaces are coated with oil of tar and sprinkled with finely powdered mercuric chloride.

Möller recommends a concentrated solution of sublimate in gum arabic mucilage, painted two or three times over the pressure surfaces of the clams. Schlampp applies to the clams a strip of gauze saturated with sublimate solution; the gauze adheres firmly on drying and greatly facilitates removal of the clams after operation.

The furrow on the pressure surfaces of the clams was probably first used with the idea of preventing the clams slipping off, an object which, without doubt, it fulfils. It also facilitates the application of disinfectants, however, and increases the intensity of the pressure, inasmuch as it concentrates it on a narrower surface.

Various forceps and screws have been constructed for closing the clams, but the instrument most commonly used is shown in Fig. 236.



FIG. 238.—Iron clams.

Bleeding may follow operation by clams which are warped, insecure, or not tight enough ; or the cord having been severed too close to the clam the artery may recede from its grasp, and occasionally the horse in an effort to remove the clam tears the cord. Secondary hæmorrhage sometimes occurs at the time the clams are removed, owing to too much force being employed, or subsequently from infection of the clot, which quickly disintegrates. The clams should not be pulled off ; it is safer to cut the fastenings and allow the clams to fall.

Clams have been condemned as unsurgical, seldom aseptic, exposing the scrotal wounds to infection, unnecessarily painful, and inconvenient. But experience shows that clams in good condition and properly applied to the cord are safe and effectual in preventing hæmorrhage, and of great advantage in the castration of robust and aged horses in either the standing or recumbent position. The greatest danger results from using septic or dirty instruments. Practitioners should exercise scrupulous care in this respect, and should disinfect all instruments before and after use. New clams should be used for each case.

Aseptic Castration. As was to be expected, soon after the practice of antiseptis became popular, experiments were made to ensure castration wounds healing by primary intention. Bayer first approached this problem in 1881, and was followed at a later date by Frick. Bayer had four successful results among fifteen horses operated upon. At that time he simply divided the cord and ligatured bleeding vessels, but frequently had secondary bleeding owing to the vessels escaping from the ligatures. He then resorted to simple ligation of the entire cord. Here also he had healing by first intention, but the horse was often compelled to lie down soon after operation on account of enormous swelling of the scrotum. In every instance he found that the ligature had slipped off. In one instance he noted the accident occurring. At every pulsation of the spermatic artery the ligature yielded, at first almost imperceptibly, afterwards at a faster rate. When the ligature was held with the finger the cord was drawn out of the loop. Frick had seven successes in twelve cases. Guttman castrated two horses, two boars, two dogs, and a goat with antiseptic precautions, in each case obtaining healing by primary intention. Plósz was equally successful with six stallions.

One must not forget, however, that observance of the necessary principles of asepsis is much more difficult in private practice than in clinical institutions. Möller operated several times, but with

varying results. The animals should be prepared, cast, and anæsthetised as above described. The necessary arrangements having been made, and the hands, instruments, and ligatures sterilised, the first step consists in thoroughly disinfecting the field of operation. The scrotum, penis, and their surroundings are carefully washed with soap and water, rubbed with alcohol, and rinsed with sublimate or other disinfecting solution. The upper hind limb and the hobble restraining it should be moistened to prevent hairs falling on the operation wound. The other precautions are similar to those suggested in connection with antiseptic operations.

The operator first grasps the right testicle, presses it towards the base of the scrotum, incises the skin, dartos, fascial layers, and tunica vaginalis, and allows the testicle to protrude. Having secured this, he ligatures the spermatic cord with two or three ligatures, according to its thickness. To facilitate operation, the cord is compressed by forceps, the ligatures are applied below this point, aseptic catgut or silk being used, and the spermatic cord is divided half an inch below the point of ligation. Any blood that may have escaped is removed with sterilised cotton wool, the wound in the scrotum closed with button sutures, the tunica vaginalis, if possible, being included, though this is often difficult. The sutures should be inserted deeply, so as to bring the subcutis in contact over a considerable area. After the left testicle has been removed in a similar way, the scrotal surface is rinsed with a disinfecting fluid, powdered with iodoform or iodoform and tannin, and covered with a thin layer of wadding, which adheres to the skin by means of the tannin, and remains as a protection after the horse rises.

The difficulties in obtaining asepsis are less apparent during operation than afterwards, inasmuch as a bandage is difficult to apply, and a really secure protection against infection can scarcely be devised. Irrigation of the wounds is usually neither necessary nor desirable, as it retards healing.

Aseptic castration has not yet been seriously practised, and is scarcely likely to become common on account of its many difficulties. Whilst ordinary castration, with exposure of the testicle, can be performed in from four to ten minutes, aseptic castration demands from half to three quarters of an hour. Moreover, it offers no great advantages. Castration by ordinary methods is seldom followed by bad results. Nielsen castrated forty-one stallions and eleven boars by torsion, without using sutures, and only saw swelling and suppuration in two of the stallions, a result which bears favourable comparison with those afforded by aseptic castration, and is worthy

of serious consideration in choosing a method. The difficulties inherent to asepsis arise partly from external circumstances, such as the difficulty of applying a protective dressing, which many animals will not endure, and partly from the fact that even with the greatest care bleeding cannot always be prevented. Bleeding usually sets in after the animal has risen, and originates in the veins of the common vaginal sheath. Blood collects in the scrotum, and endangers aseptic healing. In cryptorchids, in which this sheath is absent, asepsis is therefore more easily attained than in ordinary stallions, as is shown by the experience of Bayer, Guttmann, Plósz, and others. Until these difficulties can be overcome aseptic castration will remain a strictly academic operation.

(1) CASTRATION OF STALLIONS.

For reasons already given the second year of life is that usually selected for operation, as it appears the most generally suitable period, and the animal probably suffers less pain than it would at a later period. In this country, however, most animals are castrated during the first year. Stallions of any age can be castrated without danger, provided the genital organs are normal, and the rules of antisepsis are observed.

Before operation the scrotum is examined, to discover the existence of hernia, and note is taken of the condition of the spermatic cord, and width of the inguinal ring.

Yearlings are best kept without food on the morning of the day of castration; older, more excitable, and more powerful animals should be kept on short diet for some days before, unless they have been regularly worked. Some authorities condemn restricting the diet of animals before operation, because it favours prolapse of omentum, or bowel, and castrate yearlings and older horses without any such preparation. Such points are probably of little importance, though it cannot be denied that the small bowel is less likely to pass into the inguinal canal when full than when empty. Racehorses should not be castrated when in training, as their muscular strength is so great that bones may be broken during operation.

In England, America, France, and other countries, horses are often castrated in the standing position, though this is certainly not favourable to the proper performance of the operation, as is conceded even by supporters of the method. It succeeds well enough in quiet phlegmatic animals, which, however, can also be cast without much danger. Joyeux is believed to have been the first to castrate horses

standing. The method was afterwards modified by the American castrator Miles, and more recently has been recommended by a number of operators in England, and by Salinier, Cagny, and others in France. Joyeux operated from the right, Miles from the left side, both with clams, the former by the covered, the latter by the uncovered method. Many veterinary surgeons use the emasculator which greatly facilitates operation in the standing position; others employ the *écraseur*.

Joyeux applied blinds and a twitch, and fastened the horse up short by means of a strong head collar. After placing hobbles on the hind feet, and connecting them to a cord passed round the neck, the operator takes up his position facing the horse's right flank; with his left shoulder somewhat lowered and his left arm advanced he then grasps the scrotum and draws the testicles one by one downwards, the left hand gliding downwards along the course of the spermatic cord.

Immediately the cord has been secured by the left hand, the layers of the scrotum are successively incised from in front backwards, care being taken to protect the left thumb. On dividing the skin and tunica dartos, the testicle descends, whereupon the operator separates

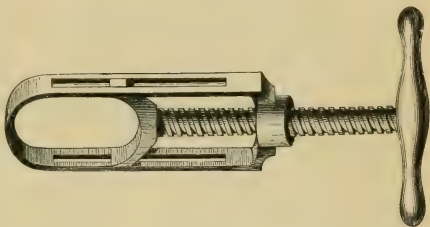


FIG. 239.—Screw instrument for closing wooden clams.

these tissues from the common vaginal covering, and the assistant, who stands at the horse's left side, passes a clam from behind over the spermatic cord. This accomplished, the operator grasps the forward end of the clam, applies the forceps or screw, and the assistant ties the clam. During the operation the forceps must be pressed towards the abdomen, and in a backward direction in order to prevent the spermatic cord being torn through. After snipping off the right testicle the left is removed in the same way.

Salinier operates by means of caustic clams, and first of all applies a ligature around the neck of the scrotum. Whilst the operator draws the testicles downwards the ligature is applied and tied by an assistant; the more tightly it is drawn the quieter does the horse remain during operation. Trasbot, whose practical experience was very great, altogether condemned castration in the standing position.

Miles castrated colts from the left side. He tied the animal up short with the right side against the wall, and placed a scaffold pole

or similar piece of round wood against the animal's left thigh in order to prevent it kicking the operator. The clam was applied over the uncovered spermatic cord and fastened with a leather ring, which was slipped over the conical end. This obviated the somewhat tiresome necessity for tying.

In England, castration in the standing position is now largely practised. Griffith describes the operation as follows :—An assistant stands at the animal's left side, with his right shoulder against the animal's left. A second assistant holds and hands the necessary instruments.

The operator, who also stands on the animal's left side, slips his left hand along the animal's abdomen as far as the scrotum, grasps the right testicle, and draws it down to the bottom of the scrotum, which is immediately opened by an incision with the right hand from before backwards. He then discards the knife. The left hand at once grasps the protruding testicle and draws it backwards, whilst the right hand passes the open clam between the hind limbs and slips it from behind forwards over the spermatic cord. Thereupon the left hand seizes the free ends of the clam and presses them together. As soon as it has been ascertained by means of the right hand that only the spermatic cord, and not a portion of the scrotum is included in the clam, the latter is grasped with special forceps and firmly pressed together. The front ends are then secured with string and the testicle cut away. The left testicle is removed in a similar way. Griffith states having thus castrated 140 horses, varying in age from one to twelve years, during the course of one summer, without any noteworthy mishap. In practising the standing operation too much restraint is not advisable, and the operator should not press or lean against the horse's flank as this may cause the horse to crouch or fall.

Abroad it is usual to cast the horse for castration on the left side, the feet and hind quarters being somewhat higher than the body, though the dorsal position also has advocates. The right hind limb is drawn forward until the hoof is in contact with the animal's chest and the whole limb is somewhat abducted, and is then secured. It must not, however, be drawn too far forwards ; on the other hand, should it not be drawn sufficiently far the operator may be injured by the point of the hock. This limb should not be fastened too tightly, as otherwise the animal may make violent extension movements, the resistance to which may cause fracture. It is preferable to pass a piece of webbing around the fetlock and hoof, and fix the limb in a position of plantar flexion.

The dorsal position has the advantage that prolapse of bowel is less likely to occur, but it necessitates more assistants; the side position is equally useful, provided a careful examination be made before operation.

Before casting, nervous thoroughbred horses should be given an anodyne, and after casting they should be anæsthetised to prevent accidents like broken back, myositis, muscle rupture, etc., which are sometimes caused by violent struggling during operation, as when the spermatic cords are compressed. Since adopting these precautions Möller and other operators have had no cases of spinal fracture. Röder claims to have rendered even the application of clams painless by injecting cocaine into the scrotal subcutis.

(A) **Castration of the Stallion by the Application of Clams.**

Although operation with clams receives first notice it has been largely replaced by other methods, and particularly by torsion of the spermatic cord, which has found increasing acceptance and on the whole seems preferable.

(a) **Castration by the uncovered method.** The condition of the spermatic cord and outer abdominal ring having first been ascertained by palpation, an assistant cleanses the scrotum, penis and surrounding parts with

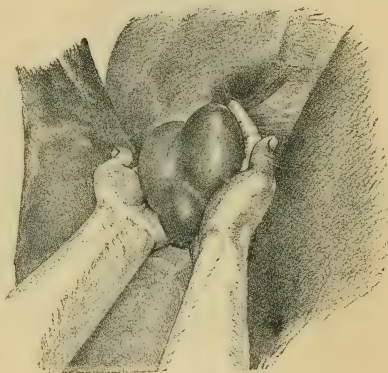


FIG. 240.

soap and water, rinses them with sublimate solution, and afterwards carefully mops up all superfluous moisture with a clean cloth or tampons of cotton wool, giving particular attention to the fold of skin between the inside of the thigh and the scrotum, so that no fluid may be left to find its way into the wound during operation. Kneeling behind the horse the operator first grasps the left testicle by passing the left hand from before backwards around the left spermatic cord. In carrying this out, the open right hand is thrust between the scrotum and the surface of the left thigh, whilst the left hand endeavours to grasp the spermatic cord from in front, and to thrust the testicle towards the base of the scrotum. The correct position of the testicle is known by the fact that the scrotal raphe

lies parallel to the testicle on its inner side. The skin covering the testicle is next rendered tense and a long incision made through it, parallel to and about an inch from the scrotal raphe, by means of a sharp convex knife. This incision divides the skin, tunica dartos, and other coverings, and may extend into the substance of the testicle itself without detriment. Some operators first incise only the skin and tunica dartos, opening the sac of the tunica vaginalis with a second incision. Nothing is gained by this method. It is, however, of great importance to make the incision in all three coats well forward and large enough, in order to provide for

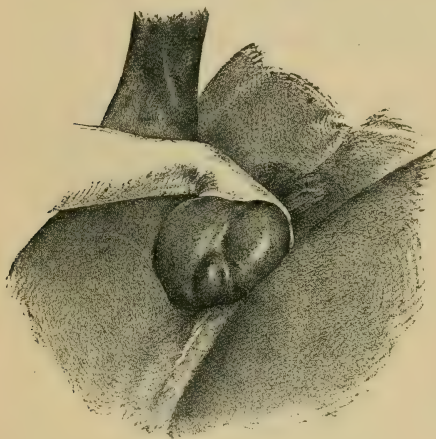


FIG. 241.

effective drainage at a later stage. This is particularly true in the case of the sac of the tunica vaginalis. The testicle will often protrude even if the scrotum be insufficiently opened, but such a method is to be avoided. Pflug and Brücher recommend first incising the tunica vaginalis reflexa in front and afterwards behind, leaving a portion in the middle undivided, and afterwards uniting the two incisions. This ensures a long opening, which, if necessary, may

be extended with scissors. The operator now discards the knife, grasps and draws forward the exposed testicle with the right hand, whilst with the left he thrusts back the scrotum and other envelopes, so as to expose the cord sufficiently to permit of the application of the clam. More extensive exposure than this should be avoided, as it only favours infection. At this moment, as a rule, animals endeavour to retract the testicle by means of the cremaster. One therefore waits a few moments, exercising steady traction on the testicle, and drawing it forward sufficiently for the clam to be applied above the epididymis. The necessary movements should be made slowly, and excessive tension or dragging on the cord should be avoided. Should contraction of the cremaster muscle be long con-

tinued, the animal may be struck smartly with the open hand, but as a rule the testicle can be drawn forward without difficulty as soon as the first struggles have subsided.

The operator then grasps a clam with the left hand and passes it from in front backwards over the spermatic cord (which should be flattened out as much as possible), giving the clam such a direction that it will hang horizontally when the animal is standing, and will at least be above the epididymis. When the cord is exceptionally long the clam should be applied proportionally higher; it may, in fact, be placed as high as possible, without exercising undue tension on the cord.

The posterior (open) ends of the clam having been compressed with the fingers of the left hand so that the clam firmly grasps the spermatic cord, the testicle may be released while the forceps or screw is applied. During closure of the clam by either of these instruments the animal usually struggles unless previously anæsthetised. To prevent injury or tearing of the spermatic cord the twitch may be shaken whilst the forceps or screw is being closed,

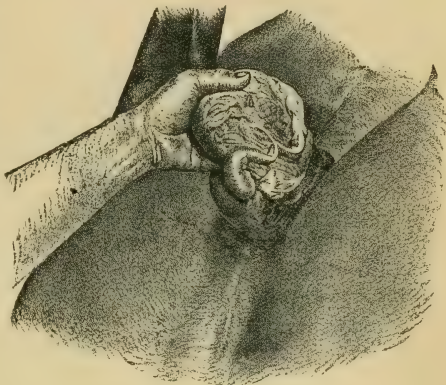


FIG. 242.

and the clam should be pressed against the animal's groin. The operator should have made sure while applying the clam that no part of the scrotum was included in it, but in any case at this stage of the operation he should again examine the parts before finally securing the clam. Care is also required to prevent the spermatic cord slipping beyond the crushing surface of the clam. Provided all is found satisfactory, the clam is secured by a surgical knot, drawn very tightly. The spermatic cord is then divided with a knife or scissors, one half to one inch below the clam.

The right testicle is then removed in a similar way, care being taken not to displace the clam already applied or to throw

any strain on the left spermatic cord. The wound and inner surface of the left thigh are then carefully cleansed, the sheath is drawn somewhat forward, the exposed stumps of the spermatic cords are powdered with iodoform, and the horse is allowed to rise.

Formerly it was usual to divide the posterior non-vascular portion of the cord before applying the clam. The method is not commendable, because the clam is then only suspended by the anterior portion of the cord, which readily yields, allowing the clam to descend. In the method described the clam, on the contrary, is

suspended by the cremaster and the vascular portion of the cord.

The horse may be placed in a well ventilated stall, or loose box, and tied up short in order to prevent its lying down. Its tail, which should previously have been plaited, is now fastened to one side by attachment to the surcingle or to the shank of a web halter passed round the neck. Most animals will at once eat hay, which should be given, as feeding distracts attention from the

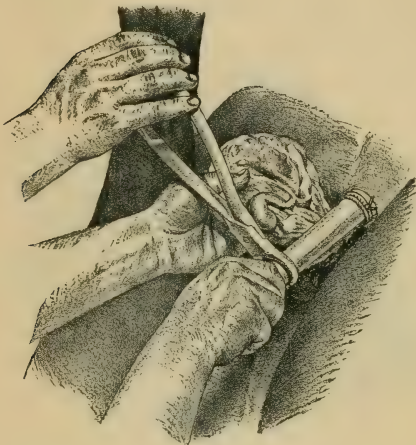


FIG. 243.

seat of operation, and prevents restlessness. Should the animal strain greatly, it should be watched, and, if restless, it may be walked about at short intervals, or given an anodyne.

In castration by the **covered method** the animal is prepared and cast in precisely the same fashion as before described. The operator first grasps the left (lower) testicle, taking particular care that the scrotum is tightly stretched over it. The incision is at the same point, but is made very long, dividing, however, only the skin and tunica dartos, and exposing the fascial layers which lie between the latter and the tunica vaginalis reflexa. By light cautious strokes with the knife these layers are divided in the long axis of the testicle until the tunica vaginalis reflexa, readily recognised by its dull

greyish-blue tint, is exposed. The knife is then discarded, the operator grasps the testicle with the right hand and with the left endeavours to free the tunica dartos, etc., from the tunica vaginalis reflexa sufficiently far for a clam to be applied to the spermatic cord above the epididymis. To facilitate the application of the clam, the connective tissue layers should, if possible, be entirely separated from the underlying tunica vaginalis. The clam, which must be somewhat larger than that used in the uncovered operation, is applied as before described, care being taken that it includes the whole breadth of the spermatic cord. After carefully tying the clam, the testicle and base of the cord are excised with a knife or scissors. The second testicle is removed in a similar way, the parts are cleansed, and the sheath drawn forwards. The horse is then allowed to rise. The after-treatment is as above described.

A modification of this method introduced by Dégive consists in opening the tunica vaginalis and exposing the testicle, but when applying the clam, grasping and drawing down the edges of the vaginal sheath so as to include them in the clam. It requires some practice, because the vaginal sheath is very apt to elude the operator, and it is difficult to again grasp and draw it forward. Attempts were made by applying a pair of forceps to overcome this difficulty and facilitate operation, but they necessitated the presence of a skilled assistant. Moreover, the only advantage this method has over the ordinary covered operation is, that when the common vaginal sheath is short, it is less likely to be overstretched. It is, however, useful when one has to deal with scrotal hernia which has only been discovered at the moment of opening the tunica vaginalis.

In castration by the uncovered method the clams are removed after twenty-four hours, in many cases even earlier; in young animals especially they may be removed without danger within six to twelve hours after operation. In Sweden and Denmark, Tidholm's method is commonly used for castrating horses. Clams are applied to the spermatic cords, which are firmly compressed. The clams, however, are almost immediately removed, a ligature is applied, and the testicles removed. In castration by the covered method, the clams are usually left in position for forty-eight hours, though Dégive recommends leaving them three to five days. Möller also approves the longer period, and finds that inflammatory symptoms are then less marked, and fever rarer than when the clams are removed forty-eight hours after operation. This is explained partly by the fact that after the clams have been several days in position the necrosing stump of the spermatic cord is not so liable to be retracted upwards,

carrying infection into the upper portion of the sac of the tunica vaginalis. It must also be remembered that after a few days the edges of the wound become infiltrated with plastic material, and are therefore less likely to be infected than twenty-four hours after operation. At the time of removing the clams, however, the greatest care cannot prevent circumstances arising favourable to infection by wound discharges. It is common experience that inflammatory swelling or fever first appears on removal of the clams.

It is best first to attempt removal of the clams without using the twitch; should the attempt fail it can be applied. Having provided himself with a clean pocket-knife, the operator places himself at the horse's left side, the left hand resting on the animal's loins; the thumb of the right hand is then placed against the front of the clam, the knife is slipped between the back ends and the string uniting them is divided. At the same time the knife is rotated in the hand, forcing the two portions of the clam apart. Discarding the knife for a moment the operator seizes the free ends of the clam with both hands, and slowly opens them as far as possible. The spermatic cord is then usually found to be adherent to one side of the clam. If no bleeding occur the cord is cautiously separated by sliding the thumb from in front backwards along the depression in the centre of the clam. The operator then throws the clam to one side, rinses his hands in sublimate solution or other disinfecting fluid, and endeavours to free the spermatic cord from any adhesion with the scrotum by passing the index finger around the stump of the cord.

If bleeding should follow removal of the clam the cord should be ligatured, or the clam may be replaced. The second clam having been removed, a strong stream of sublimate solution or clean cold water should be directed into the scrotum; this has the double effect of partially cleansing the wounds and of causing retraction of the spermatic cords.

After removal of the clams the horse should be exercised daily for half an hour or longer, or turned out; in the country full-grown horses may be put to light work. Experience has shown that long rest in the stable is disadvantageous. The good effects of exercise are largely due to the fact that they favour escape of discharge. For a similar reason it is important to make the incision through the scrotum well forward and as large and dependent as possible. The extensive swellings which sometimes follow castration are almost exclusively due to want of cleanliness in operation or to retention of wound discharges. Special treatment of the scrotal wounds is seldom necessary. They should be cleansed daily with an antiseptic

lotion until suppuration ceases. If after removal of the clams the horse is turned out the scrotum may not require further attention. When fever, or much post-operative swelling occurs, the wounds should be opened with the disinfected hand, and thoroughly washed out with an antiseptic fluid.

(B) **Division of the Spermatic Cord with the Actual Cautery.** A second method, frequently used in the horse, consists in dividing the spermatic cord with the actual cautery. It has already been described (p. 189), and has the advantages over castration with clams that it is aseptic, and that operation is at once complete. Provided proper care be taken, secondary bleeding is rare, and the local reaction, evinced by swelling, etc., is seldom more marked than after other methods. Care must be taken, however, to make the incision in the scrotum and tunica vaginalis reflexa sufficiently large to ensure free drainage.

(C) **Torsion of the Spermatic Cord** if carefully performed is also a reliable method, and has the great advantage of rendering a second visit to the patient unnecessary. Möller and many others recommend this method for castrating stallions, and it is largely practised in Germany. Operation by torsion seems less painful than castration with clams, which, even when skilfully carried out, must cause a certain strain on the spermatic cord. Moreover, healing is more rapid after torsion. In torsion the stump of the cord seldom becomes necrotic; and severe swelling, so marked after castration with clams, is relatively uncommon, and scirrhus cord is a rare sequel.

The chief and practically the only objection to this method consists in the danger of secondary hæmorrhage. By using proper forceps, and operating carefully, bleeding can, however, be reduced to a minimum, even in the case of old horses. Nevertheless the owner's attention should be drawn to the fact that slight bleeding may occur, though it is seldom of much importance. When bleeding occurs it can be stopped by the application of artery forceps to the vessel, or by ligating the cord.

(D) **Castration with the Écraseur.** In America and England the écraseur has been much used for castrating stallions. After exposing the testicle and spermatic cord the chain of the écraseur is passed over the testicle and slowly drawn tight, dividing the cord just above the epididymis. The method has found acceptance at the hands of many practical men, though it seems to possess no particular advantage over carefully performed torsion.

(E) **Castration with the Emasculator.** In England and the Colonies the emasculator is becoming rapidly popular as a very

convenient instrument for the castration of colts in the standing position.

(F) **Ligation of the Spermatic Cord** is seldom practised on the stallion. Its disadvantage consists in the fact that the ligature material remains in the wounds, causing irritation, and sometimes inducing chronic funiculitis. The use of catgut does not overcome this drawback, because it is not absorbed as rapidly from the stump of the spermatic cord as from an aseptic granulation surface; experiment has shown that absorption requires at least one or two weeks.

Moreover ligation of the spermatic cord is not so easy as might be imagined. Even when the ligature seems quite tight it may slip or become loose from the pulsations of the artery. Should the operator decide to castrate by ligation of the cords, several methods are open to him (see p. 188). The most surgical method is ligation of the spermatic artery in continuity, and when carefully performed with antiseptic precautions is quite safe.

Finally, it should be said that in castration less depends on the method than on the way it is practised. As the method most commonly employed is usually best carried out, it results that many practitioners after a short trial of a new method, return to their older procedure. Handiness and cleanliness exercise a marked influence on the success of operation. As regards cleanliness, one can never be too thorough, and although complete asepsis may not be secured, cleanliness, nevertheless, remains an important factor in ensuring success.

(2) CASTRATION OF MALE RUMINANTS.

Although the same principles apply to the castration of ruminants as to that of horses, yet variations in anatomical arrangement of the organs of generation and in external circumstances necessitate numerous modifications. Apart from goats, which appear particularly sensitive to ordinary methods of castration, ruminants seem to bear operation better than horses. Bull calves may be castrated by torsion or ligation, the elastic ligature being used if desired. Older animals may be castrated with clams by the covered method, or the emasculator may be used.

Bulls bear castration best during the first year of life, an age at which the operation is also most easily performed. Bull calves destined for early slaughter are usually castrated when two or three months old. Should the animals be intended for draught purposes,

however, castration is commonly postponed until the second year, as the neck and shoulders are then better developed.

The operation may be performed in the standing position; only old vicious bulls are cast. For operation in the standing position the animal is tied up as short and as strongly as possible, a bull holder is applied, and a rope is passed in a figure-of-8 fashion around the hind limbs above the hocks. One or two strong assistants may be placed on either side of the quarters to prevent the animal moving laterally. The operator stands behind the animal, grasping the scrotum with the left hand. Two incisions, $1\frac{1}{2}$ to 2 inches in length, are made in the lower extremity of the scrotum, the testicles are pressed out and the testicular cords are secured with fixation clams, while torsion is effected by hand or by means of forceps.

When castrating with clams, the operator incises the base of the scrotum in two places (or cuts it off), dividing the skin, dartos, connective tissue and serous coverings of the testicles. Short clams are applied to the cords which are then severed, and the clams are left in position for five or six days.

Instead of incising the scrotum in two places, the scrotum and dartos may be divided in the middle line, after which incisions are made to the right and left respectively, exposing the deeper coverings and enabling the testicles to be enucleated. A clam is then applied to each cord, or the two cords may be included in one clam.

In castration by the covered method, the procedure is identical with the preceding, except that the incision of the scrotum does not include the tunica vaginalis reflexa.

Castration with the actual cautery is performed as in the horse. Bull calves may be castrated by scraping the cord as already described. "Bistournage," *i.e.* torsion of the spermatic cords within the scrotum, is also performed. When successful it is followed by atrophy of the testicles. It has chiefly been practised on bulls, rams, and goats, and only occasionally on stallions. (See Moussu and Dollar's *Diseases of Cattle, Sheep, Goats and Swine*, pp. 751-755).

In South Germany, and especially in Bavaria, bulls are very often castrated with the "caustic ligature," that is, a strong cord saturated with a mixture of equal parts of sublimate and gum arabic dissolved in water. Many experienced operators warmly recommend this method, though some have noticed after-symptoms of mercurial poisoning, especially in young animals. An extensive eruption, which may persist for a month or six weeks, occurs over the whole body, and is accompanied by local depilation. This has been attributed to excess of sublimate in the ligature, and

some operators therefore recommend saturating it with a solution of three parts of sublimate in thirty parts of collodion. The caustic ligature has the advantage of more rapidly dividing the spermatic cord, and therefore of separating sooner, whilst the sublimate exercises a disinfecting action both on the cord itself and on the wound. Some practitioners, however, have noted severe swelling after this operation. Eckmayer ligatures the exposed spermatic cord with carbolised silk, and removes the testicle half an inch below the ligature. He operated thus on more than 100 calves without any bad result. Günther recommends the use of the elastic ligature for bulls.

Another method of castration has been recommended. After opening the scrotum the spermatic cord is perforated between the vascular and non-vascular portions with a knife, and the index finger of the left hand is inserted in the slit so produced. The testicle being removed with the knife, the stump of the cord is passed through the slit, and tied in a knot. Should bleeding not immediately stop a second or third knot may be tied. Some operators first divide the non-vascular portion of the cord with the knife, then, after grasping the blood-vessels firmly with the finger and thumb or with forceps, divide these low down near the testicle. One or more knots are then tied as high as possible on the vascular cord and drawn tight. As soon as the operator is satisfied that bleeding is no longer to be feared the free end of the vascular cord is snipped away three-quarters of an inch below the knot or knots; the latter are returned into the sac of the tunica vaginalis and thrust as high up as the fingers can reach. This method is particularly recommended for old bulls; but in calves, as the spermatic cords are not fully developed, the knots are sometimes difficult to tie. The greatest cleanliness must be observed.

Wehrhahn has shown that bulls may be castrated aseptically, though only at the cost of much time and care.

Sheep are best castrated between the fourth and sixth weeks. The animal is laid on a table (lambs are held by the legs), the limbs being grasped by an assistant or tied together; old rams should be placed on the back, and held by a couple of strong men. In lambs, scraping or torsion is the best method. Old rams may also be castrated by torsion, provided sufficient care be taken, though ligation is also successful. Clams are very seldom used in sheep. The scrotum is either opened as in the horse, or its base is cut off, a method which ensures free drainage.

Goats are best castrated by subcutaneous ligation of the spermatic cord or by means of the elastic ligature, as before mentioned.

(3) CASTRATION OF SWINE.

Swine are usually castrated during the first few weeks or months of life, though not infrequently one is required to operate on old boars. No particular danger attends castration of these animals provided that previous to operation the scrotum and inguinal canal be examined for inguinal hernia, which in them occurs with some frequency. The pig being laid on its back on a table and held by one or two assistants, the operator presses the testicles towards the base of the scrotum with the left hand. He then incises the covering of the testicles, parallel to the scrotal raphe, and about $\frac{3}{8}$ to $\frac{1}{2}$ inch distant from it, allowing the testicles to protrude. Although in young animals simple division of the spermatic cord with scissors is not always attended with danger, yet torsion is preferable, and is carried out, after dividing the posterior portion of the cord, by passing the index finger through the spermatic cord, just above the epididymis, whilst the cord is grasped a short distance above the epididymis with the thumb and index finger of the left hand. The index finger of the right hand is then rotated, and the cord twisted until the testicle falls away. Another method consists in dividing the posterior part of the cord with a knife, laying the remaining portion on the index finger of the left hand, and scraping it with a blunt knife until completely divided.

Older boars are best castrated with clams, ligature, or cautery. The operation can be performed in the standing position, though the animal's head must be firmly secured, and its hind limbs fixed by passing a couple of poles between the legs, so that it can neither lie down nor move to either side. The operation is, however, most conveniently performed with the animal lying on one side. No particular after-treatment is necessary, but the animal should be placed in a separate, cool, clean stall. The clams can be removed after twenty-four hours, though they are generally left in position until they fall away. Grün recommends castrating boars by ligating the spermatic cord with a dry, thin catgut ligature.

(4) CASTRATION OF DOGS AND CATS.

Dogs bear castration well at all ages. The animal is placed on its back, and the scrotum and tunica vaginalis are opened as above described. In young animals the spermatic cord may be simply snipped through with scissors or scraped with a knife. The point of division is just above the epididymis. In older animals ligation

is preferable, as bleeding may be prolonged by the animal licking the parts. Cats are similarly treated. Some operators fix the animal by enveloping the fore-part in a sack; an assistant holds the hind legs. Scraping, twisting, or ligation may be used.

(5) CASTRATION OF BIRDS.

This is on the whole simple, but the operation requires some practice. The cock is the bird most often castrated; the bean-shaped testicles lie in the abdomen. Operation is performed between the second and sixth weeks of life, or when the habit of crowing commences and the comb assumes a red colour. An assistant holds the bird on its back in his open hands, with its beak pointing towards the operator, and presses down the feet with his thumbs. The feathers are plucked out or cut away for a distance of about $\frac{3}{4}$ inch in front of the anus, and a transverse incision about $1\frac{1}{4}$ inches in length made through the thin abdominal wall. At this stage care is required to avoid damaging the abdominal contents. The incision is preferably made with button-pointed scissors, the thin abdominal wall being raised in a fold with dissecting forceps, incised with scissors, and the wound enlarged to the necessary extent. The operator then passes the disinfected index finger of the right hand into the abdominal cavity to the spot where, externally, the posterior angle of the scapula may be felt on the ribs, meanwhile pressing the abdominal contents to one side. At this point there lies, on either side of the vertebral column, a firm body, the size of a horse-bean—the testicle—which is first separated from the ribs by means of the bent finger, and then drawn backwards through the wound where it is simply pinched off. The removal of the testicle is indeed scarcely necessary, it being sufficient to remove it from its original position. Any protruding bowel is returned, and the wound in the abdominal wall united with closely placed stitches. The bird is placed alone in a dry run, and is given soft food and clean water. Recovery is complete in about eight days.

COMPLICATIONS OF CASTRATION IN MALE ANIMALS.

Adhesion of the Testicle to the Tunica Vaginalis Reflexa. This condition is only of importance in the operation with exposure of the testicle, and the adhesion may often be simply broken down by means of the thumb or round-pointed scissors. Where it is more extensive and firm, as shown by the fact that the testicle fails to

protrude after incision, although it may even have been incised, a second incision may be made to one side of the testicle and enlarged with button-pointed scissors until the testicle is freed. In the event of this also failing, the tunica vaginalis can be divided with scissors above the testicle or epididymis, and the base of the tunic removed together with the testicle. Should the adhesion extend to the spermatic cord, castration must be completed by the covered method.

Prolapse of the Omentum. In horses and swine portions of the omentum are not uncommonly found in the scrotum, although large portions should be recognised on examining the scrotum prior to operation. Smaller pieces may escape observation, however, and when the tunica vaginalis is opened, often become greatly increased in a short time, in consequence of the animal straining. The condition is seldom dangerous. The operator waits until the straining ceases, gently draws the piece of omentum forward, and, if it be limited, snips it off with scissors. Should it contain important blood-vessels, these must be ligatured with sterilised catgut or silk, cut through, and the remainder of the omentum returned into the inguinal canal and thrust back into the abdominal cavity. The omentum seems little prone to inflammatory processes; danger of peritonitis is small.

Prolapse of the Bowel. Though prolapse of omentum is seldom of particular importance, that of the bowel is very serious. In order to avoid this complication, the scrotum and spermatic cord must be very carefully examined before castration. A loop of bowel may, however, pass into the inguinal canal during operation, or a portion too small to be recognised with certainty by external manipulation may have been present in the tunica vaginalis beforehand. Under such circumstances, the prolapsed portion very rapidly increases in size during operation, in consequence of the animal's struggles. Prolapse is favoured by dragging on the spermatic cord, which dilates the inner abdominal ring. It occurs oftenest in old stallions, either during castration or after the animal has risen. Occasionally it appears later, sometimes when the clams are removed.

Immediately the bowel appears, however small may be the portion, the animal should be placed on its back and the hind quarters raised as high as possible. The greatest care should be taken to prevent the bowel being soiled or injured. Whilst the animal is being moved, the operator should firmly grasp the scrotum to prevent the prolapse increasing, which, under some circumstances, it very rapidly does. As soon as straining ceases, the bowel must be returned through the inguinal canal into the abdominal cavity. Should this

prove difficult, the operator may pass one hand into the rectum and assist reposition by pulling on the displaced portion of bowel. To prevent recurrence of the prolapse, a clam is applied over the tunica vaginalis reflexa; as in operation for inguinal hernia, the tunica vaginalis may be twisted around its long axis. The after-treatment is similar to that in the operation mentioned.

Entrance of Air into the abdominal cavity is, of course, only possible when the tunica vaginalis is opened, and is recognised by a sudden gurgling or bubbling noise. It is favoured by abnormal patency of the inner abdominal ring, is of rare occurrence, seldom of much importance, and only dangerous when blood passes into the abdominal cavity along with the air. In such case peritonitis may result from the introduction of infective material. Immediately the noise is heard, the operation wound should be covered with the hand.

UNFAVOURABLE CONSEQUENCES OF CASTRATION.

No special treatment is necessary after castration. Horses are placed in a clean stall or loose box provided with fresh litter. They may be tied up, and, for a time, kept under observation, in order to see whether straining occurs, in which case the animal must be checked by calling to it, as prolonged straining might easily cause prolapse of the bowel. For the next few days—or, after castration with clams, from the day when the clams are removed—the animal is walked for a half to one hour daily; in the country it may be turned out, or put to light work. Exercise favours the escape of discharge, and also tends to prevent the spermatic cord adhering to the skin wound, or the wound itself closing, which is sometimes followed by severe local inflammation and abscess formation.

During the first few days after operation it is therefore advisable to cleanse the wound with boiled water or a disinfecting fluid at least once daily, in order to prevent the edges of the scrotal wounds adhering. At a later stage this cleansing process is necessary for the removal of pus, and must therefore be continued until suppuration ceases. Provided no marked swelling or other complication appears, the animal may be returned to light work in from eight to ten days.

The most serious consequences of castration are:

Bleeding. Apart from trivial skin bleeding hæmorrhage is almost entirely confined to cases where the spermatic cord has been twisted, scraped, or torn through, and is very rare after castration with clams. Even after torsion, etc., fatal bleeding is rare. The hæmorrhage resulting from division of cutaneous vessels occurs only in drops,

is of little importance, and usually ceases spontaneously. Sometimes, however, blood escapes in a fine stream, and the operator's first task is to discover whence it comes. It may discharge from the side of the clam, and is then usually derived from the skin wound or tunica vaginalis; such bleeding may be readily checked by the use of tampons. Should it originate from the stump of the spermatic cord and discharge below the clam greater care is required, and ligation of the bleeding vessel becomes necessary. The slight bleeding which sometimes follows castration by torsion may be stopped by plugging the scrotum with tampons; more severe bleeding calls for ligation of the spermatic cord.

When the clams are removed bleeding sometimes results from tearing of small veins. Some care is therefore required in their removal; the best preventive of bleeding is to leave the clams in position for two or three days. As a rule, hæmorrhage of this kind ceases spontaneously, but should it persist, the affected side of the scrotum may be plugged with cotton wool or tow moistened with solution of adrenalin.

Excessive Swelling of the Scrotum and Sheath. As a rule, severe swelling is due to infection, with retention of discharge, consequent on the edges of the wound adhering, or to the operative wound having been too small. Long rest in the stable also favours retention of discharge and swelling. Should the operator be unskilled in grasping the testicle, he is apt (especially in foals) to make the incision too far back; the anterior portion of the scrotum then forms a pocket in which discharge accumulates, producing great swelling of the sheath. Exercise both favours discharge and tends to prevent adhesion between the spermatic cord and surrounding tissues, which in itself is a frequent cause of discharge being retained.

When unusual swelling occurs, the disinfected finger should be inserted in the operative wound, and attempts made to secure free exit for discharge. The discharge accumulates more frequently when the spermatic cord is adherent to the edges of the wound, for which reason the spermatic cord is first sought for and the index finger passed round it in order to break down adhesions; the wound is then rinsed out with a disinfecting fluid, after which the animal is given walking exercise. Infection of the wounds is best avoided by observing the principles of antiseptis.

Castration Fever. After castration without antiseptic precautions, trifling fever often appears, even within twenty-four hours. According to Fröhner's observations on 190 horses, it occurred in all but 27 per cent.; 49 per cent. showed moderate, 18 per cent. somewhat

severe, and 5 per cent. high fever. Fever most frequently appears soon after the clams are removed, especially if this be done within the first two days after castration.

Where fever is moderate, the animal should be exercised for half an hour a day. Should the temperature in the horse rise above 103° F., the wound must be carefully examined with the disinfected fingers, any discharge allowed to escape, and the parts washed out with a disinfectant. As a rule the temperature then falls in a few hours.

Septic fever is evidenced by high rise in temperature, frequent pulse, and severe general disturbance. The pulse is not only frequent, but small and weak, and the appetite is usually completely in abeyance, even water being sometimes refused. Not infrequently the castration wound shows no swelling whatever, a symptom which, when associated with high fever, is always serious. On the other hand, severe and widespread swelling, sometimes extending as far as the breast, may occur. Such symptoms call for energetic treatment. The most important point is thoroughly to cleanse the wound with a lukewarm disinfectant; other symptoms must be treated as they arise. Careful attention to cleanliness during operation is the best safeguard against this complication, and it is worth remembering that the directions given to the owner regarding the cleansing of the operation wounds are often entirely neglected.

Peritonitis. Inflammation of the peritoneum may follow castration either in consequence of the wound being infected, or of discharge being retained. In either case infection is carried upwards by the spermatic cord from the neighbourhood of the scrotum towards and eventually into the peritoneal cavity. High fever, restlessness, abdominal pain, and loss of appetite are the most important symptoms. Treatment consists in thoroughly cleansing the wound and providing for escape of discharge. Should peritonitis follow infection of the wound, the prognosis becomes extremely grave.

Prolapse of the cord consists in protrusion of the spermatic cord beyond the wound in the scrotum. It may be caused by dragging on the cord, by applying the clams too low, or by using too heavy clams. Prolapse is not infrequent in weakly animals, especially if the adhesions between the spermatic cord and outer skin be not broken down when the clams are removed. Should the spermatic cord not be soon returned into the scrotal wound or tunica vaginalis a spermatic fistula may result, and is often succeeded by chronic funiculitis or scirrhus cord.

When prolapse accompanies castration with clams, the clams should be removed, and attempts made to release the prolapsed cord and thrust it back again into the scrotum. A strong stream of cold water directed on the parts often results in the cord being retracted. Failing retraction, a clam or ligature should be applied above the prolapsed part.

Abscess formation in or about the scrotum results from infection produced by retained discharge. Infection leads to suppurative inflammation of the connective tissue and finally to abscess formation. In this case the swelling is more marked at the spot where the abscess will finally break, and is often hemispherical in shape. Immediately such symptoms are noted, the wound must be examined, and the abscess cavity freely exposed or a counter-opening made. Occasionally it is advantageous to insert a drainage-tube.

(6) CRYPTORCHIDISM AND THE CASTRATION OF CRYPTORCHIDS.

In the horse and dog, less frequently in other species, the testicles are sometimes either absent or in a state of rudimentary development. Leisering found the testicles of a stallion, which had ineffectually covered forty mares, almost normal in size, but flabby in texture, wanting the tense normal character. Their arteries were distended, their connective tissue thickened, the semen watery, transparent, and containing many round-cells, but only a few spermatozoa. Testicles which have been retained in the abdominal cavity often show similar appearances. This condition (*retentio testis*) is not infrequent in stallions of the coarse, heavy variety, but is also seen in other animals. Leisering and Gurlt found the testicles of a dog still in the abdominal cavity; Preusser has seen the same thing in pigs, and Kaiser in bulls. Imminger considers the cryptorchid condition is as common in bulls as in horses, and he has been able to establish the hereditary character of the condition in certain cases. This abnormality is termed *retentio abdominalis* when the testicle lies near the upper wall of the abdomen, *retentio iliaca* when it is near the inner abdominal ring, and *retentio inguinalis* when it is within the inguinal canal. The apparent absence of one or both testicles thus produced is termed *monorchismus* or *cryptorchismus*. During the first few months of life in the foal the testicles certainly lie in the inguinal canal, but towards the end of the first year they descend into the scrotum.

Gurlt saw a horse in which the testicles occupied a very rare position, viz. in contact with, and adherent to, the diaphragm. Sometimes they lie outside the abdominal cavity, but not in the scrotum (ectopia of the testicle); thus the testicles have been found below the diaphragm, or in the crural canal: the first condition is termed *ectopia abdominalis*, the latter *ectopia cruralis*. In dogs Möller has found one or both testicles lying beneath the skin next

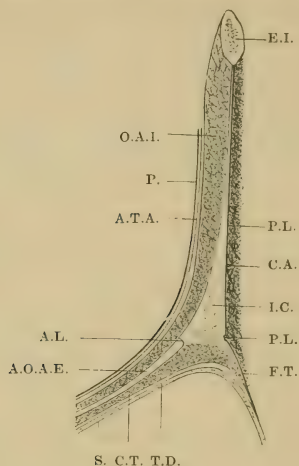


FIG. 244.—Section through the walls of the left inguinal canal. The section is through a line drawn from the centre of the lower abdominal ring to the antero-external angle of the ilium.

s. Skin. C.T. Connective tissue and fascia beneath the dartos. T.D. Tunica dartos. A.O.A.E. Aponeurosis of the obliquus abdominis externus muscle. A.L. Anterior lip of the lower abdominal ring. P.L. Posterior lip of the lower abdominal ring. I.C. Inguinal canal and its contained connective tissue. O.A.I. Obliquus abdominis internus muscle. A.T.A. Aponeurosis of the transverse abdominal muscle. P. Peritoneum. P.L. Poupart's ligament. F.T. Fascia of the thigh. C.A. Crural arch. E.I. External angle of the ilium.

the glans penis; in a bull, one testicle was met with in the subcutis of the flank.

Supernumerary testicles are said to have been seen in horses and mules. Cox found three testicles in a certain horse, and Oliver as many as four in a mule. The accuracy of these observations may, however, be questioned, as a thorough description of the supernumerary organs is wanting, and one cannot help thinking that these were cases of mistaken diagnosis.

The significance of all these conditions is self-evident. Both anorchidism and defective development of both testicles make the animal useless for stud purposes. The same is usually also true of cryptorchismus, for testicles when retained in the abdominal cavity

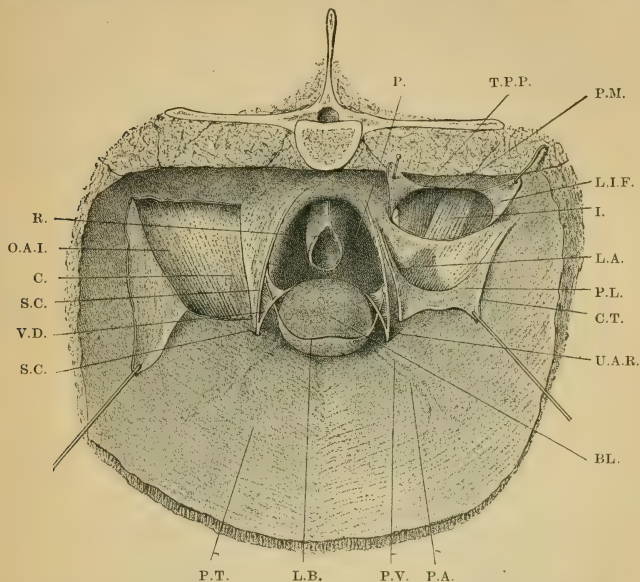


FIG. 245.—Transverse section in a perpendicular plane through the posterior abdominal region, together with a part of the supralumbar, iliac, and prepubic regions (normal).

P.T. Peritoneum. P.A. Branch of prepubic artery. P.V. Branch of prepubic vein. U.A.R. Upper Abdominal ring. S.C. Spermatic cord. V.D. Vas deferens. P.L. Poupart's ligament, turned downwards, the deep surface visible. L.A. Long adductor of the thigh. L.I.F. Lumbo-iliac fascia. I. Iliacus. P.M. Psoas magnus. T.P.P. Tendon of the psoas parvus. P. Pelvis. R. Rectum. BL. Bladder. L.B. Lateral ligaments of the bladder with the obliterated umbilical artery. O.A.I. Internal oblique abdominal muscle. C. Cremaster. C.T. Layer of connective tissue which surrounds the upper border of Poupart's ligament, the posterior margin of the internal oblique abdominal muscle, the cremaster, and the peritoneum.

are generally atrophic, lax, and either contain degenerated spermatozoa or none at all; on the other hand, retained testicles sometimes yield abundance of spermatozoa. The question of the fertility of cryptorchids was first raised by Gurlt when studying the function of the spermatozoa; his experiments seem to deny fertilising power

under such circumstances, for he was unable to discover spermatozoa in the retained testicle. Since then the same question has been variously answered. Peters considers such animals not fertile, though quite capable of coitus. Wesche, on the other hand, states having seen fertile cryptorchids; he refers, however, to a case of cryptorchismus inguinalis. A final answer can scarcely be given. The animal's fertility clearly depends on the development of the testicles. The great majority of retained testicles certainly appear degenerated, and contain no spermatozoa. Paugoué speaks of a stallion in which both testicles were retained, and whose progeny numbered amongst them five cryptorchids or monorchids, thus apparently proving the condition to be hereditary.

The retained testicle is often the seat of cysts and not infrequently malignant new growths like sarcoma, carcinoma, etc. Leisering, in the case of a dog, found the retained testicle attacked with cancer; the same condition has been seen in horses. In man, such testicles still more frequently become diseased, so that early removal is generally necessary.

The same necessity does not exist in the horse, though removal often becomes desirable on account of sexual excitement (particularly in spring) greatly interfering with the animal's usefulness. Many cryptorchids are too vicious for use. The flesh of cryptorchid swine has usually a repulsive taste, which, according to Koch, is retained even by the salted meat, and is more intense the more completely the testicles have developed.

Diagnosis is sometimes very easy, but, on the other hand, is sometimes very difficult; the exhibition of sexual appetite alone is not a reliable symptom, for "rig" horses sometimes behave like geldings and geldings like stallions. Nor is the castration scar to be relied on. The operator may have removed both testicles through one incision, or, as more frequently happens, he may have opened one side of the scrotum without finding the testicle.

Cadiot states that where the testicle has really been removed the scar always shows a funnel-shaped depression surrounded with wrinkles. By passing the finger from before backwards along the sheath, a cord, varying in size between a goose-quill and the little finger, can almost always be felt, this represents the stump of the spermatic cord, and can be traced as far as the inguinal ring. On the side of the retained testicle this cord is absent, and instead, one feels a triangular groove. Occasionally the gubernaculum testis is unusually large, and may be mistaken for the stump of the cord, but in such cases the cicatrix is absent.

To distinguish between inguinal and abdominal cryptorchidism Cadiot proposes the following method of examination :—The points of the fingers are brought together, forming a cone, and are pushed towards the inguinal ring : the testicle when in the canal is recognised as a rounded, thick, movable object. By examining the inner abdominal ring of either side *per rectum* there will be found on the side of the retained testicle a thin cord passing into the ring, which cord cannot be caused to move by drawing the sheath downwards.

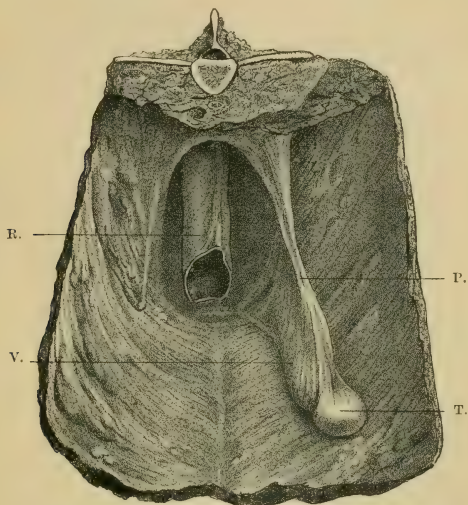


FIG. 246.—A case of abdominal cryptorchidism.

T. Testicle. P. Fold of peritoneum surrounding the spermatic cord.
V. Vas deferens. R. Rectum.

Should the animal have been castrated, however, the cord will descend as soon as the assistant moves the sheath.

When the testicle lies in the abdomen the inguinal canal is necessarily empty (unless it contain a loop of the spermatic cord or a portion of the epididymis), and the space usually lined by the tunica vaginalis reflexa is absent. To find the testicle under these circumstances Möller recommends passing the hand into the rectum, and, after first discovering the anterior edge of the os pubis, examining the floor of the abdomen with the outstretched fingers in front of, and for four to six inches on either side of, the linea alba. As a rule, the testicle is soon found ; in other cases the rectum

requires to be thoroughly emptied and the search renewed. Should the operator be in doubt as to the nature of the body found he may compress it, when, in the event of its being the testicle, the horse usually struggles. Dégive passes the hand downwards along the sides of the abdomen to the middle line. Fröhner endeavours to draw the testicle backwards towards the pelvic cavity, in order to bring it into a better position for examination. Faecal pellets sometimes mislead the operator, but may be distinguished from the testicle by the fact that they are usually firm and rounded, and may be broken down without causing pain, whilst the testicle is flat, flabby, sharply margined, very easily displaced, always retains its shape, and is sensitive to pressure. Sand compares the feel of the testicle to that of a small bag filled with mercury. The above examination is only for the purpose of determining whether the testicle is or is not retained, and is of no value for operative purposes, inasmuch as the position of the gland is often entirely altered when the animal is cast. Furthermore, it should not be deferred until immediately before operating, as the soiling of the hands and arms immensely increases the difficulty of properly disinfecting them.

The anatomical relations of the parts are very clearly shown in the accompanying figures, redrawn from Cadiot's work.

Fröhner divides the methods of operation into two, the inguinal and ventral. In the inguinal operation the incision is made a little behind the outer abdominal ring, and extended by blunt dissection towards the inner abdominal ring, in the neighbourhood of which the abdominal cavity is opened. In the ventral operation laparotomy is performed either in the region of the flank or through the lower wall of the abdomen.

Cadiot recommends only castrating such rig horses as are dangerous or difficult to handle, and in other cases abstaining from operation. He considers the beginning of the fourth year the best period, as the descent or partial descent of the testicle often occupies a long time, and when the testicle is only partially developed the inguinal operation proves difficult and sometimes dangerous. The operation demands care and practice, but with antiseptic precautions loses much of its danger, and is often of great service.

The operation is easiest in horses which have been kept low for some weeks and are in thin condition, because in them there is less fat in the inguinal region. Some days before operation a dose of physic is given to empty the bowel, and from that time the animal receives only a limited amount of concentrated food like oats, with a little

hay, but no straw. On the morning of operation the bowel is emptied by a subcutaneous injection of arecolin. Clysters are contra-indicated.

Thus prepared, the horse is cast on the side opposite the seat of operation: the hind quarters are half rolled over, and lie somewhat

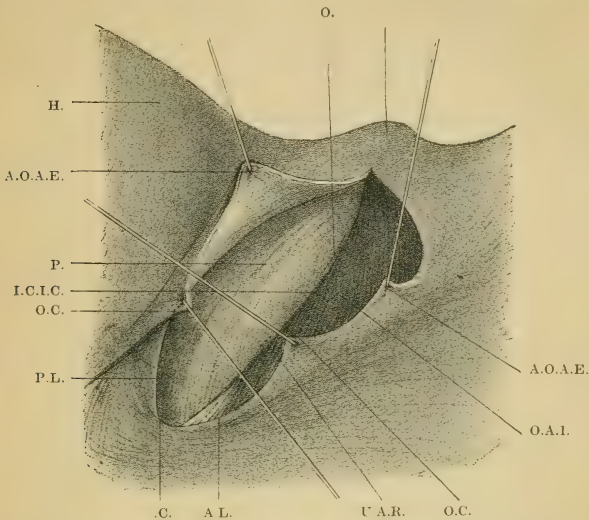


FIG. 247.—Inguinal canal, viewed from the flank. The external lip of the left inguinal ring has been removed. The aponeurosis of the external oblique abdominal muscle has been cut through a little in front of the spot where it divides. The inner oblique abdominal muscle has been separated from Poupart's ligament to a point near the inner commissure of the inguinal canal.

P. Poupart's ligament O.A.I. Obliquus abdominis internus muscle. I.C.I.C. Inner commissure of the inguinal canal. A.O.A.E. Aponeurosis of the obliquus abdominis externus muscle divided and reflected. I.C. Inner commissure of the lower abdominal ring. O.C. Outer commissure, divided. A.L. Anterior lip. P.L. Posterior lip. U.A.R. The dotted line indicates the position of the upper abdominal ring. O. The dotted line indicates the position in which the opening is made in operating for abdominal cryptorchidism. H. Hind limb, adducted.

higher than the fore. The upper hind foot is then drawn forward and fixed in position of abduction and flexion, as in ordinary castration. By previously cleansing the hoofs and lower part of the limbs and surrounding them with moist cloths, and by moistening the hair on the upper part of the thigh the seat of operation is protected against dust or infection from these parts.

Some operators prefer to secure the horse in the dorsal or semi-dorsal position, with the hocks well flexed and the thighs held widely separated by means of a rope passed round the croup from one hind limb to the other. This position greatly facilitates operation, especially in cases of abdominal retention of the testicles.

Three dishes, each containing 2 or 3 per cent. carbolic solution should be provided. After boiling, the instruments (convex bistoury, artery forceps, and écraseur), are placed in one and the ligatures and needles in the second; the third is used by the operator for moistening his hands before exploring the inguinal canal; in a fourth dish, pledgets of aseptic cotton wool are placed in readiness. The animal having been cast and partly chloroformed, the seat of operation is scrubbed with soap and water, washed with ether, and disinfected with iodine, carbolic, or sublimate solution. The inguinal region, penis, sheath, lower surface of abdomen, and inner surface of the thighs must all be included. The disinfected sheath is plugged with a tampon of cotton wool. As soon as anæsthesia is well advanced, the assistants holding the dishes place themselves near the operator, who has carefully disinfected his hands and arms and rolled his sleeves above the elbows. The operation is divided into the following stages :—

(A) An incision about three or four inches long, parallel with the raphe, is made through the skin and dartos, near the outer inguinal ring or a little forward of the position of the usual castration wound. Care must be taken to avoid wounding the large veins that cross this region; any bleeding vessels should at once be ligatured or twisted, and blood removed with pledgets of cotton wool.

(B) The connective tissue lying between the wound and the entrance to the inguinal canal is torn through with one or two fingers of both hands placed back to back. This process of dilaceration is continued down to the external inguinal ring, the posterior commissure of which lies in the angle between the prepubian tendon and the anterior border of the pubis.

(C) The index and middle fingers of one hand are then passed into the canal to ascertain if the testicle, epididymis, or any part of the testicular cord is within reach of the hand. Should the testicle be met with at this stage (*retentio inguinalis*), the operation becomes very simple, being, in fact just like ordinary castration. Sometimes, however, only a more or less short and restricted vaginal sheath, enclosing a loop of the spermatic cord or a portion of the epididymis, can be felt in the inguinal canal. Incision of the sheath with traction on the cord or epididymis may enable the testicle to be withdrawn,

though frequently the sheath is too narrow to permit the passage of the testis, which remains fixed at the inner inguinal ring or within the abdomen. As it is difficult, and even dangerous because of possible rupture, to effect sufficient dilatation of the vaginal sheath, the operator should either disregard its presence or hold it tense with one hand while the other passes to the point where the peritoneal cavity may be entered and the testicle brought through the wound into the inguinal canal.

(D) To reach the testicle within the abdomen, the hand, with fingers and thumbs extended and held together in cone shape, is introduced through the external inguinal ring and by semirotary and thrusting movements is gradually passed upwards in the direction of the haunch, occasionally pausing and applying the palmar surface of the fingers to the antero-internal wall, which becomes appreciably thinner as the hand ascends the canal, until only the peritoneum is found separating the hand from the intestines. At this point the abdominal cavity should be entered.

(E) A finger is pushed through the peritoneum and the opening is enlarged by carefully introducing a second finger. Perforation is easily made, and if the horse struggle at the moment of puncture the wound may be torn to an alarming extent. Frequently the first object encountered by the fingers on entering the peritoneal cavity is the testicle, which appears to float towards the opening. In other cases the fingers, after searching in every direction, fail to find the testicle or cord, and the hand, and if necessary part of the forearm, must be passed into the abdomen and the search continued. Palpation should be carefully practised while searching, as the testicle may be quite near the hand, but owing to cystic or other abnormality the gland may not at once be recognised. One operator recommends passing the hand towards the bladder, finding the vas deferens, and tracing it back towards the testicle. A hand in the rectum moving the intestines away from the inguinal region, is often of great assistance to the operator in his efforts to find the testicle; and in cases attended with much difficulty the effect of altering the position of the horse—as from the lateral to the dorsal position should be tried. Having found the testicle, it is drawn through the peritoneal opening into the inguinal canal and removed by the *écraseur*. Before tightening the chain, the operator should assure himself that the loop does not include any portion of intestine, which may have passed into the canal with the testicle. If prolapse has occurred, reduction must be effected before the testicular cord is divided.

In cases of double-sided abdominal cryptorchidism the operation may be performed on each side in succession, or, if the length of the spermatic cords permit, both testicles may be removed through one wound. Usually the scrotal wound is not sutured; but in certain cases, as when recurrence of prolapse of intestine is feared, the wound may be closed with five to eight silk sutures, powdered with iodoform-tannin (1-3), and covered with a layer of aseptic cotton-wool, held in place by a suspensory bandage.

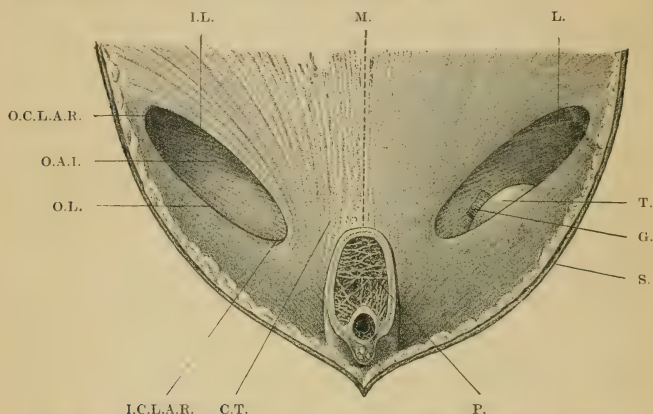


FIG. 248.—The prepubic and inguinal regions seen from below. (On either side of the middle line is visible the lower abdominal ring and the entrance to the inguinal canal.)

I.C.L.A.R. Inner commissure of the lower abdominal ring. O.C.L.A.R. Outer commissure of the lower abdominal ring. I.L. Inner lip. O.L. Outer lip. O.A.I. Obliquus abdominis internus muscle. T. Testicle covered with the tunica vaginalis propria. It has descended as far as the lower abdominal ring (inguinal cryptorchidism). G. Fibrous band representing the gubernaculum testis. L. The dotted line shows the position and direction of the opening made in the obliquus abdominis internus muscle when operating by Bang and Möller's method. C.T. Common tendon of the abdominal muscles. P. Section through penis. S. Skin. M. Median line.

This completes the operation, and the horse can be allowed to rise. In most cases the after-treatment is similar to that of ordinary castration. The animal may be placed in a clean loose-box and fed sparingly on laxative diet, and after an interval of 24 hours exercised at a walk for twenty minutes twice a day until convalescent. It is seldom necessary to tie the horse up, but when the operation has been a protracted one, the patient may be tied up for four days and kept on half rations, after which it may be allowed to lie down,

still wearing the dressings, which are removed six to eight days later.

To diminish the danger of prolapse of the bowel the stall should be higher at the back than at the front, so as to elevate the animal's hind quarters. The tail should be plaited and fastened to one side.

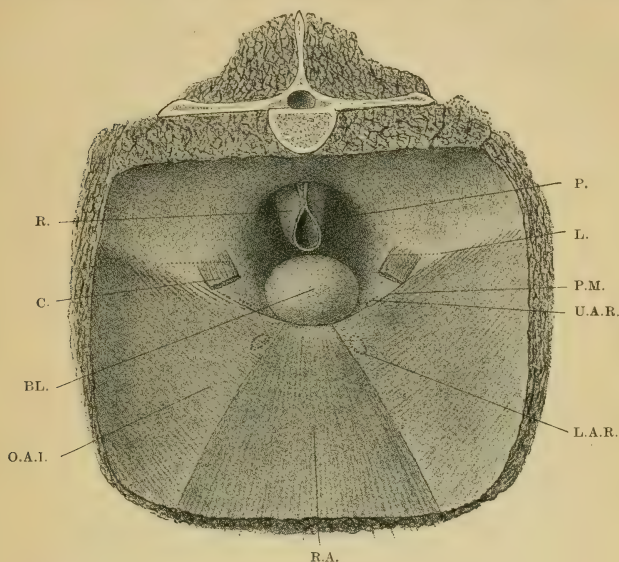


FIG. 249.—Transverse section of the posterior abdominal region in a vertical plane. This figure shows the insertion and arrangement of the obliquus abdominis internus and the cremaster. The peritoneum and transverse abdominal muscle have been removed.

O.A.I. Obliquus abdominis internus. P.M. Posterior margin of same. C. Upper portion of the cremaster muscle (divided). R.A. Rectus abdominis muscle. L.A.R. The dotted line shows the position of the lower abdominal ring. U.A.R. The dotted line indicates the upper abdominal ring. L. The dotted line shows the point at which the hand pierces the peritoneum in the operation for abdominal cryptorchidism. P. Pelvis. R. Rectum. B.L. Bladder.

As a rule, little or no pus is formed, but should it appear, the wound must be washed out daily with carbolic, or sublimate solution. Provided fever or loss of appetite is not marked, little after-treatment is necessary, and the animal may return to work in about fourteen days.

A loop of intestine may descend after operation. In such case

attempts may first be made to return it by passing the hand into the rectum and exercising traction, but if the intestine has been long exposed the horse should be cast, the gut well disinfected and carefully replaced. Bang sutures the muscular wall of the abdomen or the peritoneum.

Peritonitis, when following this operation, is usually rapidly fatal, though occasionally it takes a chronic course of several weeks before death supervenes. Exceptionally a fatal result may arise from hæmorrhage from the cord, which after section recedes and bleeds within the abdomen.

In perforating the abdominal wall Möller, like Bang, prefers making the puncture through the internal oblique abdominal muscle at the inner wall of the inguinal canal, somewhat nearer the median line than the internal abdominal ring. This produces a "button-hole wound," which does not gape, but, on the contrary, soon comes together again and prevents prolapse of the bowel. A vigorous thrust with the index and middle fingers during inspiration carries them through the abdominal wall into the peritoneal cavity. Different animals, however, present great differences in this respect; in some perforation is easy, in others it requires considerable force.

Finding the testicle or spermatic cord is always the most difficult part of the operation for the unpractised; nevertheless it can generally be effected with the first two fingers, and without introducing the entire hand. The testicle may easily be mistaken for an empty loop of bowel, but is distinguished by its sharper outline and greater firmness. The end of the epididymis is recognised as a soft mass, containing harder, firmer cords. The spermatic duct can be felt as a hard cord, and is very useful for discovering and drawing forward the testicle, for its size and hardness render it easily recognised. It can, moreover, be brought forward with much less difficulty than the testicle itself, which, when grasped and pulled on, may cause struggling. The object to seek, then, is a very small body, possessing a hard, string-like cord (spermatic cord). By gently pulling on it the testicle is drawn through the opening, though in exceptional cases the testicle may be so large as to offer considerable resistance.

Occasionally the testicle cannot be found. Even so skilled an operator as Dégive failed in four instances; Sand relates two, Bayer one or more. Should it prove impossible to withdraw the testicle Dégive advises division of the spermatic cord, allowing the testicle to fall back into the abdomen. When the enlargement is cystic Dégive brings the testicle near the inguinal ring, thrusts a fine trocar through

the abdominal wall, draws off the fluid, and is then able to pull the collapsed gland into the canal and remove it. Other operators rupture the cysts with the finger and thumb.

In one case Möller while searching for the testicle, with the entire hand in the abdominal cavity, discovered a soft body the size of two fists. This he at first took to be the urinary bladder, which on



FIG. 250.—Showing position of incision in inguinal operation for cryptorchidism.

further examination proved to be in its normal position, whilst the soft body lay near the inner abdominal ring, was movable, and carried at one end a firm object which resembled a testicle. Convinced that he had to deal with a degenerated testicle, he extended the opening in the skin and abdominal wall sufficiently far to allow the testicle and spermatic cord to be ligatured. After removing the testicle and suturing both the skin and abdominal wall with strong silk (interrupted sutures), recovery occurred without complication.

A closer examination showed that the testicle had almost entirely disappeared, and a cyst containing sixteen ounces of fluid, and having

a circumference of fourteen inches, had formed in the spermatic cord. At the lower end of the cord lay a lipoma, about the size of a duck's egg, and partly ossified. He was inclined to regard this tumour as the degenerated testicle until his attention was directed by Dégive, who had seen similar cases in his extensive practice, to hydrocele of the spermatic cord. Dégive scratches the hydrocele with the finger-nail until it discharges into the abdominal cavity, when the testicle can easily be removed.

Castration of cryptorchid boars is similar to that of horses, with the one exception that a flank incision is preferable. Levens describes a case where the castrator had removed the boar's kidney instead of the testicle, as was discovered on slaughtering the animal. The other kidney had undergone compensatory hypertrophy.

The **ventral** operation can be performed either through the flank or the lower wall of the abdomen. Both methods have been recommended, but neither is now much practised.

The horse having been cast and placed on its back, the seat of operation is thoroughly cleansed and disinfected. Günther, who adopted the low operation, made a longitudinal incision of about four to five inches, commencing opposite the free extremity of the sheath and 2 to 2½ inches distant from it and passing backwards. This incision exposed the yellow elastic abdominal tunic, which was next incised until the rectus abdominis muscle came in view. The rectus abdominis was partly cut and partly torn through as far as the tendon of the transversalis abdominis, the fibres of which were divided; the peritoneum, thus exposed, was penetrated with a sharp thrust with the forefinger. By inserting and spreading out the other fingers the opening in the transverse muscle was sufficiently enlarged in the direction of the muscular fibres to permit of the hand entering easily. The paralysing effect on the arm, due to muscular contraction, which proves so troublesome in certain other methods, was thus prevented.

Should difficulty be experienced in finding the testicle Günther advised passing the hand towards the bladder, discovering the vas deferens, and following it up to its point of origin in the testicle. Another method consists in finding the spermatic artery at its point of origin, and tracing it as far as the testicle.

Günther strongly recommended this mode of operation, but later authorities by no means support him. Fröhner condemns it entirely. He lost two out of four horses operated on: one died in consequence of the stump of the spermatic cord protruding between the widely spaced suture in the yellow elastic abdominal tunic and becoming

infected, thus setting up fatal peritonitis. In the second case the elastic tunic and the skin were very carefully sutured, notwithstanding which a prolapse of bowel occurred on the fourth day. The bowel was thoroughly disinfected and returned, but septic peritonitis occurred and proved fatal. In the next two cases Fröhner sutured each layer of tissue separately, firstly the peritoneum, then the rectus abdominis, then the yellow elastic tunic, and finally the skin. Both cases did well. Fröhner, however, drew attention to the inconvenience and difficulty of the procedure. Bayer twice successfully operated by this method.

(7.) CASTRATION OF FEMALE ANIMALS (OÖPHORECTOMY).

The castration of female animals, consisting in removal of the ovaries, is less frequently performed than the corresponding operation in the male. It is said to have certain valuable economic results; thus young pigs and heifers are thought to fatten more satisfactorily afterwards, and milch cows to remain longer in milk; bitches are castrated to prevent their breeding, and to avoid the unpleasantness associated with their coming on heat. Cows and sows are the most common subjects of operation, and for this reason will first be considered.

(A) Cows not only fatten better, but their milking period is considerably prolonged after castration. As early as 1850 Charlier recommended castrating cows thirty to forty days after the birth of the second or third calf, following which the yield of milk was said to remain steady as at the time of castration. Although this expectation has not been entirely realised, cows are still castrated in order to prolong their milk-yielding period, and to increase their capacity for fattening. The operation has been frequently revived and again abandoned. At one time in Germany and Austria it was extensively practised, but later inquiries show that it has been again relinquished, and is now seldom spoken of. Attempts have also been made to practise it extensively in England, but without much success. Even although peritonitis is avoided, the rumen is apt to become adherent to the wall of the abdomen and digestive disturbance to follow. Hendrickx claims that in one respect castration acts as a prophylactic against tuberculosis, inasmuch as it prevents the bearing of calves by animals suffering from or disposed to this disease.

Castration is successfully employed in cows as a cure for nymphomania. Albrecht operated on fifty animals with this object; forty-two were completely cured, in three cases the operation failed, and

in five cases was only partially successful. After castration the broad uterine ligaments again become tense, the milk secretion and character of the meat improve, and the proportion of fat in the milk increases.

At the present time the vaginal method is almost exclusively

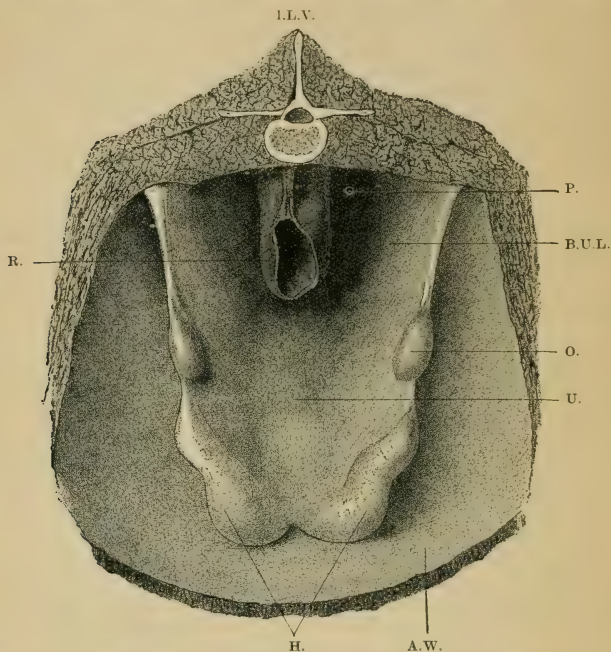


FIG. 251.—Transverse section of the posterior abdominal region in a vertical plane. The subject is a mare, and the section passes just in front of the first lumbar vertebra. The figure shows the position of the uterus as seen from below and that of the ovaries above the broad uterine ligament.

O. Ovary. H. Horns of the uterus. U. Uterus. B.U.L. Broad uterine ligament. R. Rectum. A.W. Abdominal wall. P. Pelvis. I.L.V. First lumbar vertebra.

employed for mares and milch cows; but calves, heifers, sows, and bitches, in which the vaginal cavity is too small for this operation, are spayed through the flank, or abdominal floor. To obtain the best results with cows the subjects should have attained their maximum yield of milk and be from five to seven years old. The best period for operation is six weeks to two and a half months after calving.

In the cow the ovaries lie below the transverse processes of the fourth to the sixth lumbar vertebræ, level with the external angle of the ilium, but about 2 to 2½ inches nearer the middle line. They are nearly the size of walnuts, are flattened, rounded, and of firm consistence, for which latter reason they are easy to recognise. When

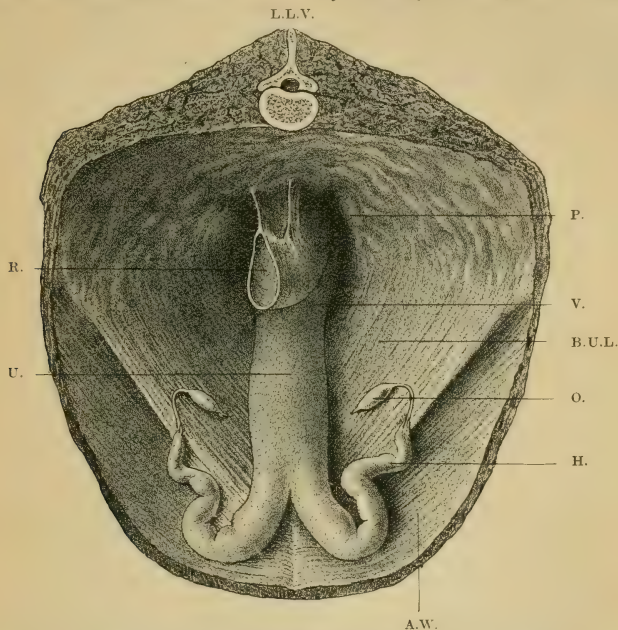


FIG. 252.—Transverse section of the posterior abdominal region in a vertical plane. The subject is a cow, and the vertical plane passes in front of the last lumbar vertebra. The figure shows the position of the uterus and the insertion of the ovaries in the uterine ligaments (seen from above).

O. Ovary. H. Horn of the uterus. U. Uterus. B.U.L. Broad uterine ligament. V. Vagina. R. Rectum. P. Pelvis. A.W. Abdominal wall. L.L.V. Last lumbar vertebra.

cystic, however, as in nymphomania, either one or both may be very much enlarged.

Charlier's operation is performed as follows :—The animal, which must be in good health, receives half rations on the evening before, and no food whatever on the morning of operation. The operation is best performed with the animal in the standing position, and in its stall. The head is fastened up short, and two men standing near the hind quarters prevent the animal moving to either side. One

of these men holds the tail whilst both grasp a round pole passed under the cow's body to prevent it lying down. In case of severe straining, on the other hand, they place the pole on the cow's back, on which they press. The rectum is emptied before operation. For this purpose Hoffmann injects six fluid drachms of glycerine. The instruments are—(1) a vaginal speculum; (2) forceps for torsion of the ovaries, or a metallic thumb-stall for scraping through their attachments, or, again, a long *écraseur*; (3) a *bistouri caché*.

All ordinary antiseptic precautions should be observed, the vulva

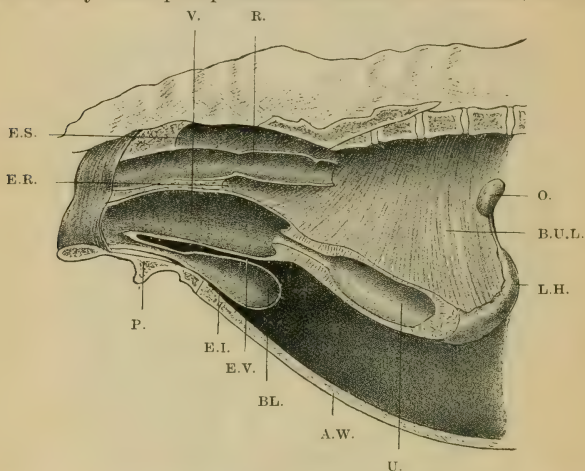


FIG. 253.—Longitudinal section in a vertical plane through the urino-genital organs of a mare.

O. Left ovary. B.U.L. Broad uterine ligament. L.H. Left horn of the uterus. U. Uterus. V. Vagina. BL. Bladder. R. Rectum. P. Section through pelvis. A.W. Abdominal wall. E.S. Excavatio superior. E.R. Excavatio recto-vaginalis. E.V. Excavatio vesico-vaginalis. E.I. Excavatio inferior.

and vagina being washed with soap and water and freely rinsed with a disinfectant. Hürliman recommends injecting a 2 per cent. carbolic solution into the vagina and afterwards drying the parts with sterilised cotton wool. One per thousand sublimate solution has been recommended for this purpose, but it causes irritation of the mucous membrane and straining, both of which interfere with operation. Needless to say the hands and instruments must be carefully disinfected.

The vaginal speculum is introduced in the closed condition, and opened by screwing the handle. The right hand holding the closed

bistouri caché is then introduced into the vagina, through the upper wall of which an incision about 2 to 2½ inches in length is made. The bistoury is then laid aside, the vaginal speculum removed, and the index and middle fingers of the right hand are passed through the vaginal wound into the abdomen, where the left ovary is first sought, and drawn into the vagina. The forceps for twisting off the ovary are next introduced with the left hand, and whilst the right hand, the thumb of which is covered with the metallic thumb-stall, grasps the ovarian ligament, the left slowly rotates the forceps

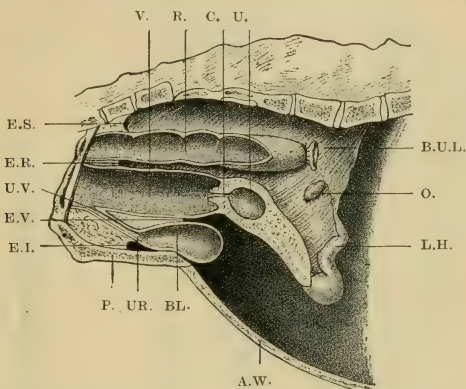


FIG. 254.—Longitudinal section in a vertical plane through the urogenital organs of a cow.

O. Left ovary. L.H. Left horn of uterus. U. Uterus. B.U.L. Broad uterine ligament. C. Neck. V. Vagina. BL. Bladder. UR. Urethra. U.V. Valve covering the opening of the urethra. R. Rectum. P. Section of the pelvis. A.W. Abdominal wall. E.S. Excavatio superior. E.R. Excavatio recto-vaginalis. E.V. Excavatio vesico-vaginalis. E.I. Excavatio inferior.

until the ovary is freed. The right ovary is removed in a similar fashion, the right hand, however, taking the place of the left, and *vice versa*. No special after-treatment is required. Any blood which may have passed into the vagina during operation is removed with the hand or with a clean sponge. The vulva is washed once or twice a day with a disinfecting fluid. Healing proceeds regularly and without complication. No special difficulty is usually found in operating, and after some practice the operation is not difficult.

When this method became better known many modifications were proposed by different operators. Colin incised the upper vaginal wall near the os uteri with a guarded bistoury (Fig. 265), without using

a speculum ; whilst Richter, in order to avoid injuring the rectum, recommended forming a fold in the upper wall of the vagina, and incising this with a *bistouri caché* fastened to a long arm, or with

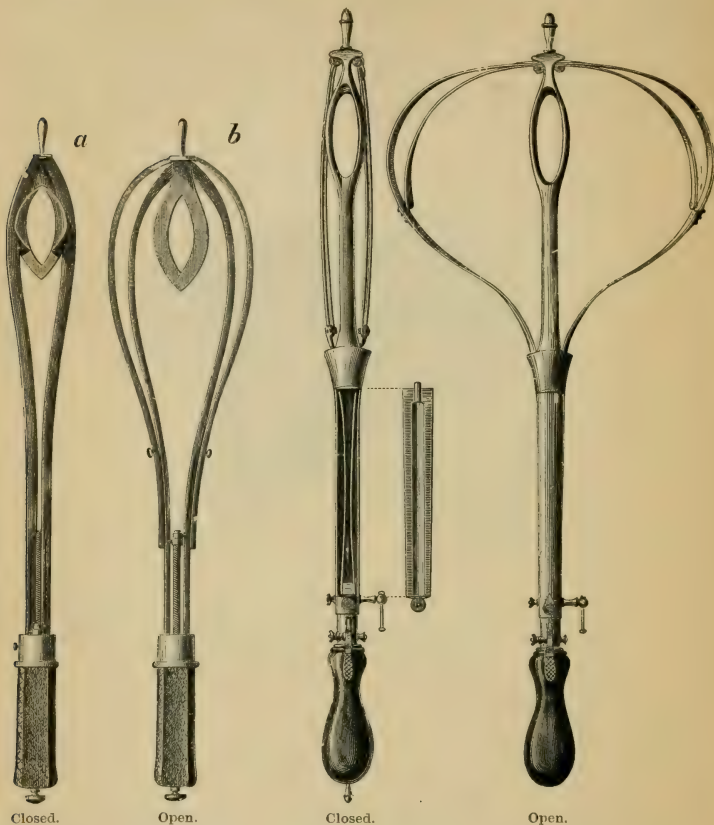


FIG. 255.—Charlier's vaginal speculum (early form).

FIG. 256.—Charlier's vaginal speculum (later form).

special long scissors. Hürliman also dispensed with the speculum, and to avoid injuring the rectum pressed the lower wall of the vagina downwards towards the bladder. Ostertag recommends incising only the mucosa, and breaking through the muscular and

serous coats with the finger; but as the serous coat may recede in front of the finger this method is not advisable.

As now practised the vaginal operation is not very difficult. A speculum is seldom employed, and the only instruments required are an ovariectomy and an *écraseur* with an extra long stem.

The animal should be prepared for some days by restricting its diet and by administering laxatives. Immediately before operation an enema is given to empty the rectum, after which the base of the tail, anus, buttocks, vulva, etc., are carefully washed and disinfected.

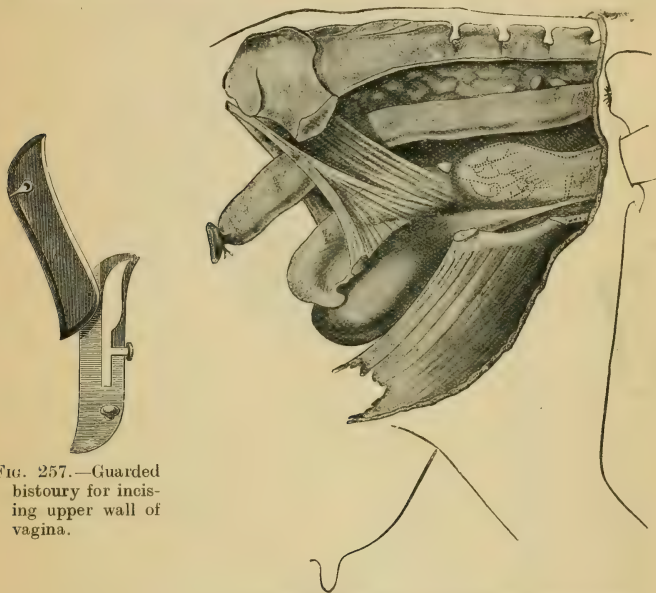


FIG. 257.—Guarded bistoury for incising upper wall of vagina.

FIG. 258.—Ovariectomy in the cow. First stage.

The vagina is washed out with a solution of a nonirritant antiseptic (protargol, carbolic acid, or hydrogen peroxide), and finally irrigated with a one per cent. solution of soda bicarbonate.

The cow is secured in a standing position in a narrow stall, and a rope is passed in a figure-of-8 fashion around the hind limbs above the hocks, while assistants pinch the spine when straining occurs, prevent lateral movements, and hold the tail to one side. Some operators administer a full dose of chloral hydrate half an hour before beginning the operation.

The instruments and operator's hands having been thoroughly disinfected, an ovariometer is carried into the vagina, which at first contracts but shortly afterwards becomes dilated, enabling the knife to be readily advanced to the seat of incision—the space between the vaginal roof and the upper aspect of the neck of the uterus. By a sharp, forward thrust the blade divides the wall of the vagina in the middle line. The knife is then dropped on to the floor of the vagina, and the right index finger is at once passed through the puncture into the peritoneal cavity, in order to make

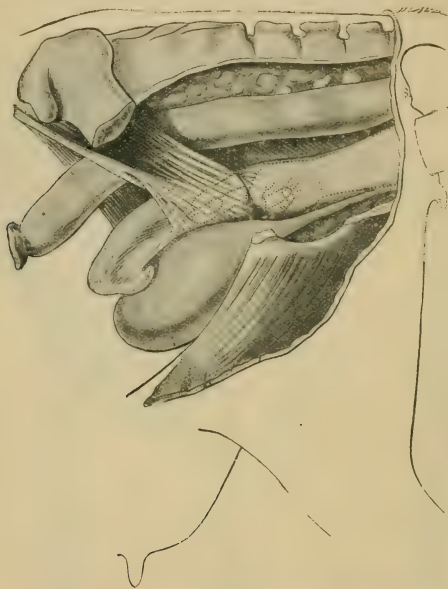


FIG. 259.—Ovariectomy in the cow. Second stage.

certain that the vaginal wall has been completely divided. By pressing on and slightly tearing the tissues the middle finger is then introduced alongside the index. As a rule, only these two fingers should be passed into the peritoneal cavity, but sometimes it may be found necessary to insert the hand. To secure the ovaries the base of the vagina is thrust forward a little, while the two fingers glide over the uterus towards one side where the horn originates. Here the fingers meet the ovary, which is readily recognised by its shape and size. The gland is nipped between the fingers and is then drawn through the incision into the vagina. The *écraseur*, with

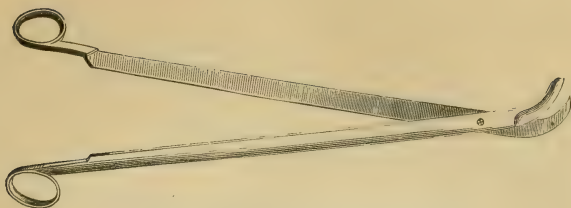


FIG. 260.—Scissors for dividing ovarian ligament.



FIG. 262.—Forceps for grasping ovarian ligament in torsion of the ovary.

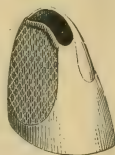


FIG. 263.—Metal thumb-stall for scraping through the ovarian ligament.

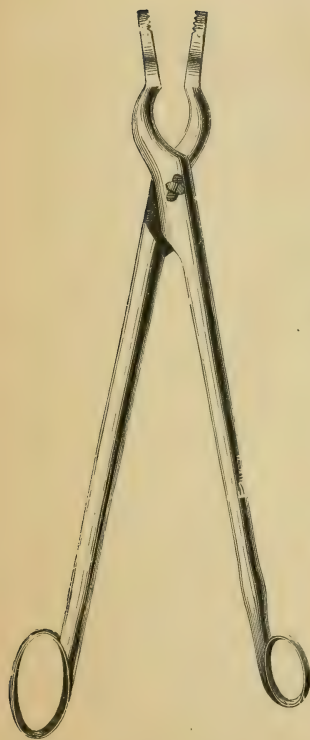


FIG. 261.—Forceps for grasping ovarian ligament in torsion of the ovary.

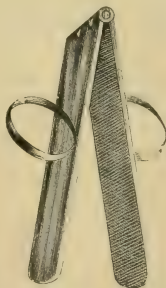


FIG. 264.—Finger clamps for grasping ovarian ligament (Colin).

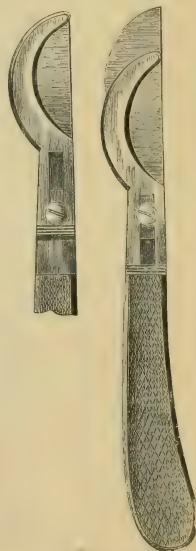


FIG. 265.—Guarded bistoury for incising upper wall of vagina (Colin).

a loop of chain projecting, is next passed into the vagina, and the ovary is slipped through the loop of the *écraseur*, which is tightened up until the pedicle is divided. The first ovary when free is left on the vaginal floor, the fingers being again introduced into the peritoneal cavity to secure the second gland, which is removed in precisely the same way.

The ovarian pedicles at once return into the abdomen, and the edges of the incised wound come together spontaneously as the vagina contracts. The operator in withdrawing his hand brings away the ovaries and knife and any blood clots that may be found on the vaginal floor.

Hoffmann describes the antiseptic method. The vulva and neighbouring parts are thoroughly brushed with warm soap and water, warm water is injected into the vagina, and the parts are cleansed with the disinfected hand. After removing the water with the hand or with the help of a rubber tube, Hoffmann rinses out the vagina with a disinfecting fluid, and again washes it with the left hand. The speculum is then passed as far as the os uteri with the same hand, and the right hand, carrying a *bistouri caché*, being introduced, an incision is made through the upper wall of the vagina. The right hand is then passed through the opening into the peritoneal cavity, the left ovary is found, grasped between the index and middle fingers, and drawn into the vagina, where it is twisted off by means of forceps. The right ovary is removed with the left hand. To prevent straining after operation a pole is passed over the animal's loins. A few hours after the operation the temperature rises to 102–3° F., but falls to normal within the next few days. Should it, however, remain high, the vagina is washed out with a disinfectant.

The vaginal operation may be followed by symptoms of colic, which are seldom serious, by hæmorrhage, and occasionally by abscess formation and peritonitis. Profuse bleeding during operation is nearly always fatal, the animal dying in a few minutes. This complication arises from accidental wounding of the aorta, or one of the iliac vessels when incising the vaginal wall. The pedicle, after

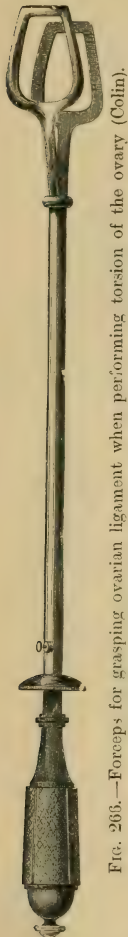


FIG. 263.—Forceps for grasping ovarian ligament when performing torsion of the ovary (Colin).

excision of the ovary, may bleed to an alarming extent, and though in some cases compressing the stump with the fingers may arrest the hæmorrhage, in others the pedicle must be ligatured. Suppuration of the wound and peritonitis arise solely from neglect of antiseptic precautions.

Protrusion of intestine through the vaginal wound is a very rare accident. Formerly, when larger incisions were made, hernia occurred frequently.

Operation through the flank may be practised in either the standing or recumbent position. Usually the opening is made in the left side, because the rumen, if not too full, is less likely to protrude than the intestine, which is apt to hinder operation through the right flank.

The animal is prepared by a restricted diet for thirty-six hours and then secured for operation. The upper region (or hollow) of the left flank is clipped, shaved, washed, and disinfected with iodine, or a five per cent. solution of carbolic acid. In the middle of this space a vertical incision, or one slightly inclined forwards or backwards, and about four inches long, is made through the abdominal wall. The skin, fascia, and muscles are carefully divided layer by layer down to the peritoneum, which is not opened until the bleeding from the muscles has stopped. The peritoneum is punctured with a director and the wound is then enlarged to the same extent as that through the muscles. A hand is passed into the abdomen, over the rumen and downwards towards the right pubic border of the pelvis, to secure the right ovary, which is drawn nearer the opening and removed by the *écraseur*. The left ovary is removed in the same way, both glands are brought outside the abdomen, and the cutaneous wound is closed by sutures and covered with a protective adhesive.

In opening the flank, some operators endeavour, by dividing the layers of the abdominal wall in different directions, to effect more or less overlapping of the wounds of the skin and muscles, but this object can be more conveniently attained, at least in the recumbent animal, by having the left hind leg drawn well back before incising the flank.

(B) Female lambs are seldom castrated. Obich operated on ten-weeks-old animals from the left flank. The incision was sufficiently large to admit the index and middle fingers into the abdomen. The ovaries were drawn towards the opening and were snipped off with scissors. In twelve cases healing was uninterrupted, but in one lamb an abscess occurred at the point of operation.

Hering castrated six two-year-old sheep from the flank for the purpose of discovering whether the yield of wool would prove greater after operation. In two only the left ovary could be reached. The operation was well borne, though it failed in its object. The animals fattened earlier than their fellows.

(c) Mares are castrated for nymphomania associated with viciousness, and unilateral castration, removal of the cystic ovary, is sometimes performed in mares which are barren in consequence of ovarian disease.

Cadiot has frequently practised this operation, and on the whole has had good results, although in some cases the object, viz. to render

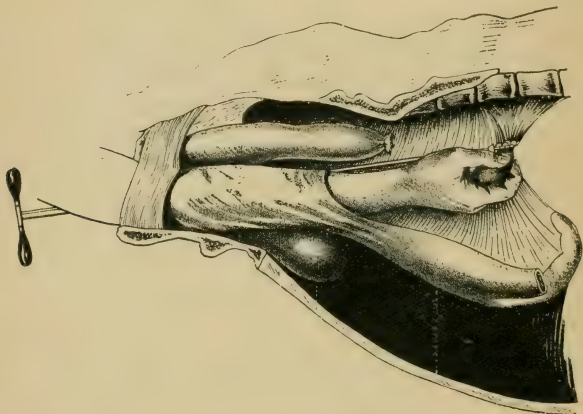


FIG. 267.—Ovariectomy with the écraseur (Cadiot's method).

animals quieter and more tractable, has not been attained, a point to which Harms and Thomassen had previously directed attention. In mares, however, castration is always more difficult and more hazardous than in cows.

The principal danger consists in the well-known sensitiveness of the horse's peritoneum. The difficulties consist partly in the fact that irritable and well-bred animals can seldom be operated on in the standing position, this only being possible, as a rule, in coarse-bred horses, which can be restrained in a trevis. Furthermore, in the mare the ovaries are much further removed from the vulva, and the ovarian ligament is shorter than in the cow, so that it is impossible to draw the ovaries into the vagina, in order to effect torsion. The operator therefore has to introduce both the hand

and the instrument into the peritoneal cavity, necessitating a much larger vaginal wound.

In the standing position the operation resembles that in the cow. Should a trevis or an operating table not be at hand, the mare, half an hour before operation, should be given a full dose of chloral hydrate and afterwards placed in a stall. The recumbent position is preferable in most cases, and to prevent straining general anæsthesia is employed. The rectum must be entirely emptied. Hard fæces in the rectum expose the bowel to injury when the vagina is

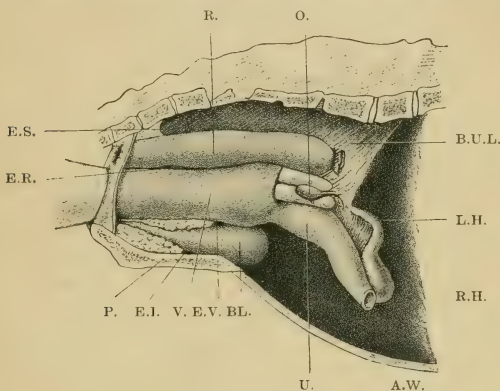


FIG. 268.—Longitudinal incision in a vertical plane through the posterior abdominal region, pelvis, and urino-genital organs of a cow. The section is somewhat to the right side of the median plane. The figure illustrates the second stage of ovariectomy: the hand is grasping the left ovary.

O. Ovary. U. Uterus. V. Vagina. R.H. Right horn of the uterus (cut through). L.H. Left horn of uterus. B.U.L. Broad uterine ligament. R. Rectum. BL. Bladder. P. Pelvis. A.W. Abdominal wall. E.S. Excavatio superior. E.R. Excavatio recto-vaginalis. E.V. Excavatio vesico-vaginalis. E.I. Excavatio inferior.

incised. As in the cow, the vaginal wall is punctured above the os uteri, after preliminary cleansing and disinfection of the vagina, the vulva, and its neighbourhood. The injection of irritating fluids into the vagina must be avoided. Even one per thousand sublimate solution, especially if used warm, may irritate the mucous membrane and cause straining, which hinders operation. The best disinfectant is a cold solution of lysol or carbolic acid, one per cent.

The hand carrying the knife is passed into the vagina and directed towards the convex uteri. At first, depending on the degree of anæsthesia, the hand may be closely embraced by the vagina, but by moving the hand to and fro for a few seconds the vagina

dilates, affording ample space for making the puncture at the proper point—in the middle line of the forward depression between the upper aspect of the cervix and the superior wall of the vagina. After perforating the vagina, the opening is enlarged by inserting and separating the fingers. The hand introduced into the peritoneal cavity traces the uterine horn forwards to its extremity, where the ovary lies among the folds of intestine. In mares suffering from nymphomania the ovaries are often as large as a duck's egg. They can be distinguished by their firm consistence and their mobility. The left ovary is grasped with the right hand, and the *écraseur* having been introduced with the left hand, the chain-loop is passed over the ovary. At this stage the operator must make sure, by feeling with the right hand, that no portion of bowel is included in the loop of the chain. The operator steadies the *écraseur* with the left hand, whilst an assistant turns the screw, and so tightens the chain until the ovary is free in the operator's hand. To prevent hæmorrhage the screw should be turned slowly—especially towards the close of the crushing process.

The detached ovary having been withdrawn into the vagina, the right ovary is removed in a similar way, if necessary the operator's left hand replacing the right, and finally the ovaries and instrument are brought outside and the vagina is carefully disinfected.

The patient should be placed in a clean, well-bedded stall or loose-box, and for a few days fed lightly on mash diet. Gradually increasing exercise should be prescribed for ten days and if no symptoms of sickness occur the mare may then be sent to work.

In the mare the use of the *écraseur* is undoubtedly preferable to torsion of the ovarian ligament with forceps, the risk of injuring the bowel being much less. The *écraseur* must be considerably longer and stronger than those used for ordinary castration; Delamotte uses one twenty-four inches in length. The chain of the *écraseur* must also be stronger, otherwise it is very liable to break.

Cadiot adopts Colin's method of cutting through the peritoneum, and condemns the suggestion to divide it with the fingers, on account of the serosa dissecting off and forming a pocket. Cadiot's general procedure in the mare resembles that in cows, but he lays special stress on disinfection of the vulva and vagina. The parts are injected and washed with 3 per cent. creolin solution daily for two or three days before operation. He also draws attention to the fact that immediately after operation animals are apt to show colic, which continues from two to four days. He condemns irrigation of the vagina after operation.

Castration of mares is not often followed by a fatal result, though sometimes owing to accidental wounding of the uterus, or bowel, or to infection conveyed by the hand or instruments peritonitis sets in, causing death within thirty-six hours. Fatal hæmorrhage should not occur if the vagina is incised with ordinary care at the proper place. In both mares and cows castration may be followed by chronic inflammation with suppuration of the pelvic connective tissue close to the vaginal wound. This complication arising from infection at the time of, or subsequent to operation, may continue for months, and even prove fatal. Adhesions may also form between the vagina and bowel or wall of the pelvis, and lead to twist of the bowel, with fatal results. Bourgués saw a mare die of twisted intestine caused in this way three months after castration. Delamotte reports a case of a mare in which abscess formation followed castration. Luckily the abscess discharged into the vagina and recovery occurred.

(d) The castration of the sow is gradually being discontinued. The improved races of swine exhibit sexual appetite to a less degree than the old breeds. They remain on heat for a shorter time, and their fattening suffers little in consequence, so that castration has become more or less superfluous.

The operation is usually performed at the age of six to ten weeks—seldom in old breeding sows, although they bear the operation well—but should not be performed while the animal is in œstrum. The best time for castrating old animals is from four to six weeks after parturition.

In swine the ovaries hang from the long, flexuous, bowel-like uterine horns, which, at the age of six weeks, are about the size of a goose-quill. The ovaries, small, irregular, and enclosed in a fold of the broad ligament, are situated a little behind the point corresponding to the angle of the haunch. It is possible to reach both ovaries through one flank, or by introducing a probe into the uterus and thrusting the organ towards the linea alba to remove the ovaries through the abdominal floor. For this reason two methods of operation are in use, one through the flank and one through the lower wall of the abdomen. The first is practised as follows:—

The animal is placed on the right side, and the hind legs are held extended backwards under the operator's left arm by an assistant, whilst the operator presses the animal's head and neck on the ground with his right foot.

The knife usually employed has a short broad blade, with a rounded cutting edge, and is unprovided with a spring, so that it can easily be opened or shut with one hand. After clipping away

the bristles the primary incision is made in the skin of the left flank, in front of the outer angle of the ilium, in the direction of the external abdominal muscle, or from above downwards and backwards. Other operators make it at right angles to the vertebral column. The opening must be sufficiently large to permit of the index finger being introduced through the abdominal muscles and peritoneum. During an inspiration, or at the moment when the pig squeals, the finger is suddenly thrust through the abdominal tunics, thus preventing the peritoneum dissecting away from the abdominal wall, which would not only render the operation difficult, but might also lead to troublesome sequelæ. With the index finger in the abdominal cavity, the operator first secures the left ovary, which is the size of a bean, of firm consistence, and lies nearly equidistant from the external angle of the ilium and the middle line of the sacrum. When the ovary or the uterus is grasped the animal usually squeals, a fact of considerable importance in guiding the operator. The left ovary is drawn outwards and held by the right hand, whilst the index finger and thumb of the left hand gradually bring the left horn of the uterus into the wound, and finally into the right hand. As soon as the point of union of the two uterine horns becomes visible, the operator draws forward the right horn, together with the right ovary, in a similar fashion. Both ovaries are now nipped or torn off, or excised with a knife. In young animals the entire uterus is often removed without bad effect. In older sows only the ovaries are removed, and care must be taken not to draw forward the body of the uterus. The uterine horns are then returned to the peritoneal cavity, the skin wound is sutured, and the animal placed alone in a clean, cool stall. During the ensuing twelve hours it should only receive clean water or small quantities of readily digestible food.

Many modifications of these methods have been suggested. In older sows, the abdominal muscles are also cut through, leaving only the peritoneum to be divided with the finger. Should the operator attempt to divide the muscles by means of the finger in such animals, a pocket is formed into which a coil of intestine may pass, become adherent, and cause death, either from peritonitis or from incarceration. In such cases the operator is often erroneously blamed, it being thought that he has sutured the bowel to the abdominal wound.

Beginners are advised to perform a few experimental operations in order to gain experience, otherwise they may be unable to find the ovaries. The extreme dexterity which can be attained, however

is shown by the professional castrator. Bowman, for a wager, castrated 100 sows in 160 minutes.

(E) Castration of bitches is performed for the purpose of avoiding inconvenience caused by the animal coming on heat. When young, and not too fat, these animals appear to bear operation well. The manipulation is more difficult than in swine, and can only be mastered by considerable practice, especially when the operation is performed through the flank. In the bitch, the ovaries lie much further forward, near the kidneys; they are small, often enveloped in fat and the ovarian ligament is short. The uterine horns are shorter and less flexuous than in the sow.

The bitch may be secured like the sow, or may be laid on its right side on a table and anæsthetised. The incision is made near the last rib, and about $1\frac{1}{2}$ inches below the transverse processes of the lumbar vertebræ. It should be about $1\frac{3}{4}$ inches in length, and should follow the direction of the outer oblique abdominal muscle, which may be divided at the same time as the skin. In the event of the operator desiring to remove both ovaries from one side, which is only practicable in small animals, the incision must not be made too far forward. On the other hand, when an incision is made on either side, each may be placed somewhat further forward.

The abdominal wall is pierced with the index finger of the right hand as in swine, and the finger is passed towards the sublumbar region in order to find the ovary, which is the size of a bean, and lies close behind the kidney. Though the ovary may not be found, the horn of the uterus is almost immediately encountered and should be drawn forward, when the ovary will be discovered, and can be nipped or cut off. By utilising the left horn of the uterus, the right may also be drawn forward and the ovary removed in a similar way. Both horns of the uterus are then returned to the peritoneal cavity, and the skin wound is sutured.

To prevent the peritoneum stripping away from the abdominal wall and forming a pocket, some operators, after dividing the outer skin and abdominal muscles with a knife, perforate the peritoneum with a director instead of with the finger. The director is then thrust into the abdominal cavity, and the opening enlarged by passing the knife along its groove. This prevents injury to the bowel.

It is often difficult to draw forward the right ovary, especially if the incision be made far forward. Some of the most experienced operators recommend making a second incision in a similar position on the right side, and repeating the process.

In castration through the abdominal floor, which is easier for beginners, the animal is placed on its back on a table and anæsthetised.

A long probe, with a slightly bent end, is passed along the upper wall of the vagina into the uterus; the end is then turned towards the lower abdominal wall, so that its presence can be recognised about $1\frac{1}{4}$ to 2 inches in front of the edge of the os pubis. At this point an incision $1\frac{1}{4}$ to 2 inches in length is made close to the linea alba, the peritoneum is pierced with the finger, and with the help of the probe the uterus is discovered; from this the ovaries are easily found, and can be removed by torsion, or by the knife after ligation of the ligament. The skin wound must be carefully sutured and treated antiseptically. It has been suggested that in young animals a double ligature might be applied close behind the point of bifurcation of the uterus and the organ divided between the two ligatures without the operator troubling to discover the ovaries. Whether this would destroy the sexual appetite or only the reproductive powers seems doubtful.

Several German veterinary surgeons recommend operating in the linea alba, breaking through the broad uterine ligament, and cutting off the ovaries after ligation with catgut. The abdominal muscles are united with catgut, the skin with silk, and a surgical dressing is applied by means of a bandage passed round the body.

The most important complications are fatal bleeding and peritonitis. Death from bleeding seldom results after the first twenty-four hours, but peritonitis may prove fatal within a period of from two to ten days. Fatal bleeding is best prevented by ligation of the pedicle, and peritonitis by observing antisepsis, as in all operations that include interference with the peritoneal cavity.

(F) Castration of birds consists in dividing the oviduct. The birds are held by an assistant as in caponing, and an incision about $\frac{3}{4}$ to $1\frac{1}{4}$ inches in length, and about the same distance from the anus, is made through the abdominal wall. The disinfected forefinger is introduced, the rectum thrust to one side, and the oviduct, which lies below the rectum, and can be recognised by its white colour, is grasped with forceps. The duct is then drawn forward, and cut across with scissors about three quarters of an inch in front of its junction with the rectum. Some operators excise a portion. After returning the ends the wound is sutured as was described in connection with caponing.

By slowly exercising pressure on the lower portion of the bird's body the oviduct can be forced outwards through an incision made above the anus. It is then cut through, and the incision sutured.

During the ensuing three or four days the birds are kept apart in a cool, quiet place, and receive light food.

Extirpation of the ovaries is dangerous in hens, and as castration by division of the oviduct is sufficient, oöphorectomy is not practised.

DISEASES OF THE HEAD.

I.—DISEASES OF THE LIPS AND CHEEKS.

(1.) WOUNDS AND BRUISES.

IN horses, wounds of the lips frequently result from bites or kicks, from collisions and falls on hard ground, or from entanglement with sharp portions of the harness, or with nails, hooks, etc., fixed in stable racks and mangers. Bruises are produced in a similar manner, and by the severe and repeated application of the twitch. The corners of the mouth may be injured by thin or badly-fitting bits, especially in young and hard-mouthed horses, or in those suffering from brain disease, whilst the cheeks are sometimes lacerated by kicks, horn thrusts, and, on their inner surfaces, by the sharp edges of the molars. Cattle at grass may suffer from torn wounds produced by dogs, while sporting dogs may be bitten by the quarry.

The great mobility of the injured parts, and the constant soiling which occurs during mastication, almost always interfere with the healing of bruises and contused wounds. On the other hand, reparative processes are assisted by the richness of this region in blood-vessels and loose connective tissue, so that healing sometimes takes place by primary intention, even when wounds are extensively bruised, their edges already dry, and their flaps dissected from underlying tissues over considerable areas. Deep wounds in the corner of the mouth, where the mucous membrane is divided and the opening of the mouth lengthened, give most trouble. Perforating wounds of the cheek also heal with difficulty, and sometimes produce fistulæ. Injuries to the great venous plexus in the cheek occasion considerable bleeding, which, however, is seldom dangerous. The division of Stenson's duct often results in salivary fistula. Emphysema of the facial region frequently accompanies wounds of the cheek, but calls for no special treatment, and usually disappears spontaneously. Necrosis of the margins of wounds may produce defects in the lips and cheeks, which both injure the animal's appearance and interfere with feeding and drinking. Such defects frequently follow wounds in the corner of the mouth, where the buccal opening becomes lengthened (Makrostomy).

Treatment. In surface injuries, small flaps of skin can be removed with scissors, when healing usually follows. To prevent deformity following extensive injury, attempts should be made to bring about healing by first intention. After removing loose shreds, the wound, which is usually dry, must be freshened, *i.e.*, the surface removed with the scalpel to furnish the moist or bleeding flaps necessary for immediate union. The wound and its surroundings are then cleansed, the neighbouring long hair removed, the parts flooded with some fluid disinfectant, and the edges brought together as evenly and completely as possible. On account of the great mobility of the lips, pin sutures are here preferable. The pins should be inserted deeply and at distances of about $\frac{1}{2}$ to 1 inch, being secured by a continuous thickish thread applied in a figure-of-8. Ordinary sutures sometimes suffice. For further security, and to fix the edges, the wound may be smeared with collodion or wound gelatine, over which may be placed tow, jute, or strips of gauze.

Deep wounds at the corners of the mouth or on the cheeks require particular precautions. Button sutures are most useful, and the thread, which must be strong, should be passed right through the cheek; lead or brass wire is also suitable. Injury to the wound can be avoided by putting the horse on the pillar reins. Where healing by primary intention is desired, water alone must be given for the first 24 hours, and during the following few days only gruel or bran mash. After six to eight days the stitches can be removed from the lips, but those in the corner of the mouth or in the cheek should be left a couple of days longer. In fistula about the cheeks the hardened walls are removed by caustics or the actual cautery, and a purse-string suture inserted. The inner opening of the fistula may sometimes be closed by passing a suture through the mucous membrane.

(2.) ACUTE INFLAMMATION OF THE LIPS AND CHEEKS.

Acute inflammation of the lips in the domesticated animals is frequently caused by licking blistering ointments, by irritating materials, by infectious disorders, like aphtha or stomatitis pustulosa, or by such injuries as have previously been referred to.

Specific inflammations are treated of in works on internal disorders. Dogs, being much exposed to infection, sometimes show cellular inflammation of the upper and lower lips after slight injuries.

Diseases of the skin, like eczema and mange, are not infrequently transmitted to the lips as a result of licking the diseased spots. Thence they generally spread to the bridge of the nose, producing a dermatitis chronica apostematosa, which gives great trouble, especially if the area involved is too great to permit of all diseased skin being removed with knife and scissors. The follicular inflammation of the lips in young dogs, associated with lymphangitis and suppuration in the submaxillary lymphatic glands, described by Fröhner, is probably due to extensive outbreaks of acne pustules. A similar affection in an old dachshund was described in the *Berliner Tierärztliche Wochenschrift*. Death resulted from general infection.

In dogs and cattle, spontaneous necrosis of the cheek occurs, resembling noma of children. In dogs the disease begins with formation of a minute lesion at the corner of the mouth; the great swelling which simultaneously appears indicating the character of the malady. The skin is soft, greyish-brown, and easily removable; the submaxillary lymph glands are swollen, and fever and severe salivation exist. In dogs the process seldom terminates before destroying a large portion of the cheek. The appearance of granulations and of pus formation on the boundary indicate the commencement of healing. After the necrosed portion sloughs, the molars may become visible, and great difficulty exist in taking fluids. In spite of this, complete recovery usually occurs; difficulty in feeding disappears, and even the animal's outward appearance does not permanently suffer. The disease is rare in dogs, and its cause is as little understood as that of noma in the human subject, though it probably consists in infection by the necrosis bacillus or other micro-organism.

Treatment. The parts should at once be cauterised. Where this is impracticable, lotions of permanganate of potassium, carbolic acid, or sublimate can be applied. Thin fluid nourishment is indicated, and may be given from a bottle. As soon as the defect in the cheek interferes with feeding, fluid or semi-solid nutriment becomes indispensable. If required, animal broths may be given. Stockfleth has described a similar disease in cattle, resulting from injuries, but this does not extend as in dogs. Most commonly an abscess forms in the cheek, and recovery occurs in a few days. The treatment of other inflammatory processes should be adapted to their special features. The cause must be removed and care taken that the affected part is not irritated more than necessary, either by rubbing or by mastication. Attention is accordingly required in

selecting and preparing the food, and in the management of the animal. Complications are treated on general surgical principles. In suppurative forms of skin inflammation, diseased parts should be promptly removed with the knife.

Chronic inflammation of the lips and cheeks in oxen is sometimes due to **actinomycosis**. Klepzw, who examined 2,000 slaughtered cattle, found actinomycosis of the lips in 5·6 per cent. Several hard, painless swellings appear in a line with the molars. The skin covering them is at first mobile, but later becomes adherent and finally breaks, a muco-purulent fluid being discharged from the wound, which is surrounded by flabby granulations which readily bleed.

The cause is infection with the actinomyces from the cavity of the mouth.

Treatment consists in early opening of the swellings, drastic curetting of the parts and dressing or plugging with tow saturated in tinct. iodi. Potassium iodide should be administered.

Like actinomycosis in cattle, **botryomycosis** of the lips and cheeks in horses is not uncommon. Small fibrous swellings form, most frequently at the points where skin and mucous membrane are coterminous.

Treatment should be undertaken early; it consists in removal of the swellings, careful disinfection and suturing of the wound. For this affection potassium iodide may be administered, but its effect is uncertain.

(3.) TUMOURS OF THE LIPS AND CHEEKS.

Warts. In dogs and horses the lips are not infrequently the seat of great numbers of small warts. These new growths occur both on the mucous membrane and on the skin, and vary from the size of a pin's head to that of a pea. Their covering is often wanting in pigment, in consequence of which they appear red on the surface and are often thought by laymen to be parasites. They are almost always found in young animals, and though often unsightly, sometimes bleeding, they appear to cause no particular inconvenience, and may disappear after a short time without apparent cause. Papillomata may be transmitted from one dog to another; though attempts to inoculate other animals have proved ineffective (Garcia). If mastication be interfered with, they can be removed with scissors; but if they cause no inconvenience it is better to await their spontaneous disappearance.

Encysted tumours also occur frequently on the lips of horses; they lie close under the mucous membrane, sometimes attain the size of a pigeon's egg, and contain a thick, fluid, honey-like material. They are really retention cysts, produced by obstruction of the ducts of mucous glands. So long as they attain no considerable size, nor become the seat of inflammatory changes, they are seldom observed. To detect them, the thumb is laid on the external skin, the fingers on the mucous membrane of the lip, which is allowed to glide slowly through the fingers. When such tumours become inflamed, they cause enlargement of the submaxillary lymph glands, displace the lips, and impart to the face somewhat of the appearance of facial paralysis. If they become inflamed, or interfere with feeding, treatment will be required. It is generally sufficient to lay open the parts and dress the interior with nitrate of silver, sulphate of copper, 2 per cent. corrosive sublimate solution, or 10–20 per cent. solution of chloride of zinc.

Atheroma. A cyst develops above the base of the false nostril in horses, usually resulting from occlusion of a sebaceous follicle. It is filled with a granular material. It may become as large as a hen's egg, is



FIG. 269.—Atheroma of the false nostril.

round, painless, and freely movable, but seldom causes any difficulty in breathing. By passing the finger into the false nostril, it may be readily felt, and is sometimes visible from without. (Fig. 269.) Such growths are seen oftenest in young foals. They are easily removed. The animal is cast—though in very quiet subjects this is scarcely necessary—and an incision made through the skin in the long direction of the head. The cyst is then grasped with forceps and freed from its surroundings, care being taken not to incise it, as its removal is thus rendered more difficult. Should such an accident happen, a dark-grey, granular material is discharged, and the inner wall of the cyst comes in view. The nasal mucous membrane being firmly adherent to the swelling may be injured, when froth from the nostril will appear in the wound. But even where the mucous membrane has been cut, healing by primary intention occurs. The wound is at once sutured, and finally

covered with iodoform collodion or wound gelatine. Tempel removed a dentigerous cyst from a horse's upper lip. With the exception of those named, new growths on the cheeks and lips are comparatively rare in domesticated animals. Fibromata, sarcomata, carcinomata and melanomata have been seen and operated on with varying success, depending on the kind and age of the tumour.

Treatment consists in careful removal of the new growths, which is seldom very difficult if the knife be used early and boldly.

(4.) PARALYSIS OF THE LIPS. FACIAL PARALYSIS.

The facial is the motor nerve of the muscles of the ears, eyelids, nose, lips, cheeks and subcutaneous muscle of the neck. Arising from the pons, it enters the inner ear with the N. acousticus, passes through the Fallopian canal, and outwards through the stylomastoid foramen of the petrous temporal bone, penetrates beneath the parotid gland, and then passes over the posterior border of the lower jaw, on the external surface of which it divides into several branches which join the superficial temporal nerve to form the subzygomatic plexus.

Paralysis of the facial nerve occurs rather frequently in horses, but is rarer in oxen and dogs. It is commonly confined to one side, often to the nerve supply of the upper lip; the deformity consequently is slight, and the mischief may be overlooked. But double-sided paralysis interferes very noticeably with feeding, and therefore with nutrition, while at a later stage the respiration in fast paces may be impeded owing to paralysis of the nostrils.

The cause is most frequently external injury impairing the conductivity of the nerve. The malady is therefore common in horses which, in consequence of colic or injuries to the feet, lie a great deal. Siedamgrotzky first noted that this nerve often becomes bruised at the point where it turns round the lower jaw. The cheek-straps of the head-collar, and especially the buckle at the left side, may easily injure the nerve when the animal is lying. The double-sided paralysis described by Grebe, and erroneously regarded as reflex paralysis, is similarly produced. In earlier times facial paralysis was often caused by inserting hair setons in the cheeks as a remedy for disease of the eye. It occurs during the progress of serious infectious disorders, such as influenza, petechial fever, etc., and may

also be produced, as in man, by severe chills. Utz saw the condition after an animal had been struck by lightning.

The paralysis is mostly confined to the facial muscles. The lips are distorted, the nostrils narrowed, the upper lip, and sometimes the under, are drawn towards the sound side. The condition is best recognised by looking at the lips from in front. So long as one side alone is affected, feeding is little interfered with; but in double-sided paralysis the lips hang flaccid, a condition best seen in the under lip, and feeding now becomes slow or extremely difficult. The food can only be grasped with the teeth, and, in drinking, the corners of the mouth must be immersed in order to prevent the water flowing back. Even when carefully tended, animals rapidly lose condition, for they have difficulty not only in grasping food, but, owing to the paralysis of the cheeks, also in masticating it. The food cannot be brought between the opposing rows of teeth and so accumulates between the cheeks and molars. These are the appearances when injury has occurred at the point where the nerve passes round the under jaw; but where in addition the subzygomatic nerves are involved, sensation is lost in the skin of the affected side.

Facial paralysis due to central injury or disease is different both in its symptoms and consequences. Should the lesion be sufficiently near the brain to involve the zygomatico-temporalis nerve, then, in addition to the above appearances, paralysis affects the levator palpebrarum, as well as various muscles of the ear. The upper eyelid droops (ptosis) whilst the orbicularis palpebrarum is unable properly to close the eye, and the external ear on the affected side hangs limply (Fig. 270). Zahn found the eye of the affected side smaller, and the cornea cloudy. Disturbance of hearing could also be detected. Not infrequently paralysis of other portions of the body accompanies paralysis of the facial nerve; thus Jewtichilew saw hemiplegia, Tempel paralysis of the trigemina lnerve, and Fuchs of the hypoglossal and glossopharyngeal.

The causes are various. Tumours, developing in the parotid, as well as disease of the Fallopian canal, may cause pressure on the nerve. Occasionally the origin is central. Thus the post-mortem of a horse suffering from double-sided paralysis, disclosed sarcoma of the pons. Götze noted paralysis of the lips and ears in a horse after influenza, and found on section an abscess in the cerebellum. In another case, Lydtin saw sarcoma of the petrous temporal bone, the growth extending from the posterior convolutions of the cerebrum to the point of origin of the twelfth nerve. Thomassen and Hamburger found hæmorrhage in the facial nerve centre. In

a dog that suffered from unilateral paralysis Monfallet found tuberculosis of the meninges.

It is difficult to say if rheumatic paralysis of the facial nerve occurs in animals as well as in men. The greater number of cases, at any rate, are of traumatic origin. Disease of the middle ear being rare in the horse, it cannot often be a determining agent, and Möller has never seen a case of facial paralysis in dogs, though in them middle ear disease is comparatively common. But Trofimow relates that a bitch showed one-sided paralysis in consequence of catching cold; the upper eyelid was involved; cure was effected in two



FIG. 270.—Right-sided facial paralysis (central). The protrusion of the tongue is accidental—it does not necessarily occur in facial paralysis.

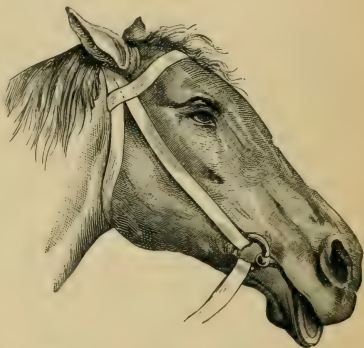


FIG. 271.—Double-sided facial paralysis (peripheral).

months, but a relapse is said to have occurred later. Cattle seldom suffer from facial paralysis, probably because the nerve is protected against mechanical injury by the horns.

In double-sided paralysis both nostrils fall in, but a sufficient opening remains for ordinary quiet respiration. Immediately, however, that breathing is hurried, from such causes as excitement or rapid movement, a snoring sound becomes audible during inspiration. As the horse breathes only through the nose, the narrowed opening becomes insufficient, the edges of the nostrils are pressed inwards, and inspiratory dyspnoea ensues. That asphyxia is always caused, as Claude Bernard stated, has not been borne out by the experiments of Günther and Ellen-

berger. Möller's observations support those of Ellenberger, but it must be allowed, as shown in a case related by Schöneberger, that an animal affected with this form of paralysis, if excited and forcibly driven, may not only suffer from severe dyspnoea, but may even succumb. In one case of double-sided peripheral paralysis the breathing was of a snoring character, even when the patient was at rest, whilst during inspiration the nostrils became contracted and the false nostrils collapsed (Fig. 272).

Diagnosis of central paralysis is not difficult, though determination of the cause and its exact position require much care. Should the paralysis be confined to one or both lips, it is peripheral; where the muscles both of the eyelids and ears are affected at the same time, the injury is above the point where the nerve turns round the jaw. Central paralysis may sometimes be recognised by the continued existence of reflex irritability in the affected parts, showing that conductivity of the nerve is not destroyed.

Prognosis. Many cases of peripheral paralysis recover in from four to six weeks. Return of irritability on faradisation points towards recovery, and this usually occurs gradually. When the animal is in a state of rest, it may be noted that the lip is returning to its normal position; should it be excited, however, the distortion again becomes visible. A prognosis is, therefore, best arrived at while the patient stands quietly in the stable. Cases of incomplete paralysis generally recover; those in which the eyelids and ears are affected are not hopeful, and where tumours are the cause a cure is not to be expected. Further, when the paralysis has been in existence for more than two or three months, the prognosis is always unfavourable. Double-sided is generally less hopeful than single-sided paralysis, while, if the appearances point to some central cause, little hope of cure can be entertained.

Treatment. In one-sided incomplete paralysis the food which has accumulated in the cheek must be removed after each meal. Nothing further is necessary. In complete paralysis of one side, soft, easily masticated food should be given, and the skin over the neck of the lower jaw, where the nerve crosses the bone, rubbed with a mild



FIG. 272.—Position of nostrils and nose in double-sided (peripheral) facial paralysis (from a photograph).

counter irritant. Such measures serve to satisfy the owner, and the rubbing certainly appears to promote recovery. The frequently recommended injection of veratrine into the cheek over the course of the nerve has proved of little value. Electricity is seldom successful owing to the excessive sensibility of the horse to this agent. Goubaux advised electricity and counter-irritation; and Baldoni in a case of facial diplegia treated by the continuous current obtained recovery in a month. In double-sided paralysis the principal point is attention to the food, which should consist of mashes, gruel, and green stuffs. Corn should be given crushed and in a deep receptacle, so that the animal can more easily seize it with the teeth. To avoid the tendency to dyspnoea, Schöneberger advised that wire sutures be passed through each nostril, and brought together over the nose; while others recommend the excision of a portion of the external wall of the nostril. Tracheotomy is sometimes useful.

Voigtländer observed periodical attacks of cramp in the region supplied by the N. facialis in a horse; "on the right side the upper eyelid began to twitch, a slight contraction like a shadow ran across the masseter as far as the lip, and then began powerful contractions, which drew the right half of the upper lip upwards and outwards, and set in motion the entire half of the head behind the eye." These attacks came on every five minutes, and occurred even during feeding. The owner stated that the disease had been in existence for several years.

A peculiar condition, probably nervous, described as "involuntary shaking of the head," from the predominant symptom, is sometimes seen in horses and often in ponies, especially during the warm months of summer. On pulling up after exercise, or even in the stable, the animals shake the head more or less violently according to the case, the movement, continuous or intermittent, being from side to side, or up and down. The cause is unknown, but the symptoms have been attributed to neuralgia, parasites in the nasal chambers, and to abnormal blood pressure in the brain. Treatment by purgatives or sedatives (bromides and chloral) appears to give only temporary relief, but section of the superior maxillary nerve at its exit from the infraorbital foramen has been more or less beneficial.

Dégive noticed paralysis of the tongue and lips in horses, a disorder which is said to be frequent in Belgium, and which has a certain resemblance to bulbar paralysis in man. He found general progressive paralysis of the bulbar nerves, which was attended with salivation, paralysis of the masticatory muscles and of those of the tongue and lips, with consequent difficulty in eating, portions of the food falling out of the mouth. Paralysis of the soft palate and pharyngeal muscles was sometimes present and interfered with swallowing. The malady always ended in death, generally

in five to six months, sometimes later. Post-mortem showed gangrenous pneumonia (mechanical pneumonia), atrophy of the roots of the bulbar nerves (hypoglossal, vagus and facial), and degeneration of the muscles of the tongue and cheeks.

II.—DISEASES OF THE MOUTH.

(1.) FOREIGN BODIES IN THE MOUTH.

IN domesticated animals, and especially in dogs and cattle, foreign bodies taken into the mouth along with the food, or picked up in play, are apt to become fixed in position. In dogs, bones and needles are the most common objects; in cattle, pieces of wood, which lie between the teeth or the teeth and cheeks; while needles usually penetrate the tongue or palate. The animals salivate, are restless and exhibit chewing movements when the mouth is apparently empty; some shake the head or make cautious attempts to swallow; and, if the foreign body is not removed, they become thin from insufficient nourishment. Where such symptoms are met with, the mouth should be carefully examined. The objects being often very small, like needles or splinters of wood, it is necessary to search closely. Where hard bodies become fixed between the upper and lower teeth, the mouth can sometimes neither be closed by the animal itself nor by external force. In dogs and cats, sewing needles are often fixed in the base of the tongue.

Apart from difficulty in feeding and loss of condition, other symptoms may supervene. A horse has been seen to die of bleeding from the palatine artery, primarily brought about by a needle penetrating the tongue. Most veterinary surgeons have removed pieces of bone from between the molars in dogs, which were unable to close their mouths, and in consequence had been suspected of rabies. Lindenberg saw epileptiform attacks in a cow result from a sharp molar injuring the tongue, attempts to eat immediately producing an attack. To remove a foreign body the mouth should be forced open, and the object seized either with the hand or with forceps. Needles are nearly always found penetrating the tongue from behind forwards, assuming this position in consequence of the struggles of the animal when choking, or the attempts it makes to displace the needle.

Injuries to the hard palate are sometimes complicated with severe bleeding, and require most careful attention. When the palatine

artery is wounded, the animal may bleed to death, as the movements of the tongue interfere with thrombus formation. In venous bleeding the following treatment is generally sufficient: after covering the tongue with flour to the thickness of an inch, the mouth is firmly bound and the horse left at rest for 6—8 hours. In severe arterial bleeding from the hard palate, the mouth should be held open with a gag, and the actual cautery applied to the bleeding point; or the horse may be cast and the artery ligatured. Under some circumstances pressure may be employed, as, for instance, in injuries of the anterior parts of the palate. After placing on the injured spot a pad of tow, preferably soaked with adrenalin solution, a bandage is passed over it, and firmly tied around the jaw, beneath the upper lip. This should remain in place for 12 hours.

In spite of the unpleasant smell, wounds of the mouth usually heal rapidly after removal of the foreign body. Where deep cuts exist, the mouth should be cleansed after each meal and the animal prevented, either by muzzling or tying up short, from again soiling the part.

The tongue is sometimes strangulated by a cord or rubber band; this has repeatedly been seen, both in horses and dogs. Sometimes with the view of keeping the horse quiet during grooming, or occasionally from malice, a piece of string is tied round the tongue. Kirchner relates a remarkable case of the kind in a cow, where the tongue became snared in consequence of chewing some string. In dogs and cats, sections of blood-vessels or elastic bands sometimes slip on to the tongue and remain fast. In one of the two cases described by Barrier, a section of aorta was found encircling the tongue, which was necrotic. Carrucci relates a similar case, where the tongue was swollen to four times its normal size. Kitt, when making a post-mortem examination of a goat, found an iron ring, $\frac{3}{4}$ inch broad and $2\frac{3}{4}$ inches in circumference, firmly fixed round the tongue. The animal had shown difficulty in eating and was finally killed.

Such a condition is recognised at the first glance by the great swelling and bluish-red colour of the tongue. The affected portion is sharply defined posteriorly and the adjoining part is still perfectly normal. Closer examination discovers the encircling object, which may at first be hidden by the swelling. The condition is one of strangulation, and, if not relieved, necrosis of the tongue results from interference with circulation and nutrition. But this necrosis does not always set in rapidly, and recovery sometimes occurs, even where the tongue is already insensible and cold, and of a bluish-

black colour. In these cases, however, the surface of the mucous membrane is destroyed and eventually cast off.

Treatment. The first thing is to remove the foreign body. This may be sufficient, but is not always, for the mucous membrane, being relatively thick and strong, is unable to yield to the extent required by the excessive swelling, and the tongue runs a risk of becoming necrotic. In such cases, scarification is advisable, longitudinal incisions being made with the bistoury over the whole swelling, and to the extent of half its thickness. Deeper incisions might wound the lingual artery and give rise to profuse and dangerous bleeding. The swelling generally subsides rapidly after this operation, but at times may continue for several days. When necrosis is well established the affected portion of the tongue should be excised; or in cases where extension of the necrosing process is threatening, amputation through sound tissue should be performed. Bathing with alum solution assists healing and checks putrefactive changes. As long as much swelling remains, fluid nourishment must be given, and in cats and dogs this may appropriately be administered as a drench.

(2.) DISEASES OF THE TONGUE.

MECHANICAL INJURIES.

With the exception of those wounds previously described produced by foreign bodies, injuries to the tongue occur most frequently in horses. The use of the bit or halter sufficiently accounts for this. Moreover, stablemen, in order to control unruly or sensitive horses during grooming, not infrequently pass a cord around the tongue. If this be sharply pulled the tongue may be cut and the frænum torn, and the thinner the cord the more easily does the accident occur. Snaffle bits, especially if worn, produce the same effect. In horses and ruminants the tongue may also be injured by sharp or displaced teeth.

Laceration of the frænum linguæ also occurs in horses, sometimes resulting in suppuration, and the production of a fistula or sinus. In oxen the dorsum of the tongue may be abraded by rough fodder. Steffen saw the point of a foal's tongue become gangrenous and slough, after having been violently handled during some dental operation. His report of the case points to a blood-vessel having been ruptured. The injuries so frequently found near the base of the tongue in oxen are not always of a traumatic nature; more frequently they are due to actinomycotic infection, which will be described later. The

dog often bites his own tongue, or that of another dog, in fighting or playing.

Diagnosis presents no difficulty. The irritation in the mouth, salivation, want of appetite, "quidding" of food, or slow, cautious mastication readily indicate the nature of the injury and its extent. Healing is usually rapid and certain, though transverse wounds of the tongue may leave a deep depression. But even this is no great drawback, and is only worth notice inasmuch as the animal wastes food in eating, and the tongue may be lacerated if forcibly handled during examination. But a portion of the tongue may be torn away in the first instance or later, and if the *frænum linguæ* be involved, mastication will be rendered difficult.

The attempts to cure protrusion of the tongue have shown that in horses the removal of 3—4 inches causes no inconvenience. But where more is lost the animals are unable to bring the food between the back teeth. At times they seek to effect this by holding the head in the air like chickens when drinking, but at best some food must be wasted, and mastication takes longer.

Graf records that a horse, which had lost the point of the tongue, had severe swelling of the remainder, accompanied by salivation and inability to eat solid food: only fluids and mashers could be taken. When the wound had cicatrised, the stump only extended about $\frac{3}{4}$ of an inch beyond the first molar. In three weeks the horse could again eat ordinary food, but took three times as long as formerly to do so. Lüdecke described a similar case, in which the tongue was lost as far as the border of the *frænum*, but nevertheless the horse could eat as usual. Cadiot and Dollar describe two cases, in one of which the right side of the tongue was lost from a point just in front of the first molars; recovery occurred in about three weeks, and there was no subsequent difficulty in prehension or mastication. In the other the tongue was divided transversely, the stump only extending two inches below the first molars. Despite the mutilation there was no difficulty in grasping or masticating food ("Clinical Veterinary Medicine and Surgery").

In dogs defects in the tongue interfere especially with drinking, as some of the water flows back. But in time both dogs and horses learn to eat and drink in the usual manner. The superficial vessels are sometimes torn, but as the lingual artery may not be divided, the nutrition of the anterior part of the tongue is seldom interfered with. When, however, this artery is torn, necrosis of the point of the tongue may easily follow. Severe bleeding after the injury is, therefore, an unfavourable symptom. Cagny shows that even

severe injuries to the tongue may heal. The end of a horse's tongue had almost been cut off about four inches from the tip by a rubber ring; nevertheless the wound entirely healed, without suturing and without loss by necrosis.

Treatment consists in carefully cleansing the cavity of the mouth after each meal. The horse is then either muzzled or tied up, to prevent it soiling the wound by eating. Clean water should always be kept in the stall. Deep wounds, *i.e.*, such as reach nearly half through the tongue, should be sutured. Very strong silk is the best material, and the stitches are inserted deeply and close together, otherwise they are liable to tear out. If in transverse wounds the point of the tongue appears to be necrotic, amputation may be considered, but unless unmistakable signs of spreading necrosis exist the operation should be deferred, for not infrequently the tip may be preserved, even where the wound extends three quarters through the thickness of the tongue. Profuse bleeding results on division of the lingual artery, but if the horse has been cast for operation the vessel can easily be taken up with forceps and tied. Amputation by galvanic cautery, or elastic ligature obviates this complication. Injury to the frænum often leads to formation of abscesses, which may require to be opened. Under any circumstances, the parts must be kept scrupulously clean.

ACUTE INFLAMMATION OF THE TONGUE (GLOSSITIS ACUTA).

Compared with injuries produced by external agencies, acute inflammatory processes in the tongue are seldom seen; but specific inflammations, the result of infection, occasionally occur, especially in cattle and horses. Infection is particularly favoured by hard prickly fodder. Cattle and horses usually suffer in consequence from acute glossitis, which often becomes enzootic, and is clearly due to the entrance of pathological micro-organisms. That septic processes and cellular inflammation may extend from the pharynx to the tongue is shown by Fürstenberg's observations on sheep.

The tongue swells at some point and becomes hard and painful. The swelling increases, feeding becomes difficult, and salivation soon sets in. In cattle, excessive œdema about the pharynx occurs at an early stage, and the lymph glands become swollen. Should an abscess form in a superficial position the pus is usually discharged into the mouth, but deep-seated abscess of the tongue often breaks in the submaxillary space, and in cattle discharges a peculiarly offensive pus.

Singard observed a similar disease in young cattle leading to necrosis of the tongue; and reports finding bacilli in the necrotic parts, which, even after many cultivations, reproduced the disease. Gresswell described an enzootic glossitis terminating in necrosis, and stated having found bacilli which were identical in appearance with those of malignant oedema. Stockfleth also gives an account of gangrenous glossitis in cattle and horses. Kolb noticed in cattle an inflammation of the tongue characterised by severe salivation and oedema of the pharynx, with painful swellings on the frænum linguæ varying in size from a pigeon's to a hen's egg. The swellings were scarified soon healed, otherwise they formed abscesses with foetid contents. Rehms reports a similar condition in horses.

Diagnosis and treatment must be founded on the character and extent of the disease. In general, scarification is indicated, to allow disease products to escape and prevent necrosis. Should fluctuation appear, recourse may at once be had to the knife. After treatment consists in thorough local disinfection, and feeding with nutritious fluids or semi-solids.

CHRONIC INFLAMMATION AND NEW GROWTHS IN THE TONGUE (MAKROGLOSSIA).

Under the names of tuberculosis of the tongue, degeneration of the tongue, wooden tongue, and chronic inflammation of the tongue, many different conditions have been described, which have a certain similarity, inasmuch as in all the tongue gradually becomes larger and thicker, and eating and breathing are rendered difficult.

The nature of these processes until lately was doubtful. Numerous foci being found in the lungs, they were described as tubercular. Siedamgrotzky, in view of their pathological and anatomical appearances, suggested that they were due to the entrance of some irritant. More recently they have been carefully investigated and it is clear that several diseases have been confounded. Micro-organisms such as actinomyces, botryomyces, and tubercle bacilli have frequently been found, and less often psorospermia. At times no cause whatever can be assigned for the chronic inflammatory process by which the fibrous tissue of the tongue increases at the expense of the muscles. Tumours are much less common in animals than in men, in whom carcinoma and syphilis furnish a large number of tongue cases. The ox is the most frequent sufferer, and in it disease is generally due to actinomyces. Pflug has urged, however, that chronic indurating glossitis does not always result from actinomycotic infection, but may be due to hyperplasia of the

muscular connective tissue. Imminger has found only 4 to 8 per cent. of these tongue diseases to be due to actinomycosis. Probably staphylococci are sometimes the cause. Truelsen and many others have detected actinomyces in the horse's tongue. Compared with actinomycosis, tuberculosis of the tongue in oxen is very rare.

GLOSSITIS CHRONICA INTERSTITIALIS FIBROSA.

This disease, first described by Truelsen as occurring in the ox, consists essentially in simple hyperplasia of the interstitial connective tissue of the tongue. The tongue feels hard and craunches under the knife. The cut surface is smooth and greyish white. The muscular substance has almost disappeared. Imminger describes two forms, viz. : (1) Disease of the tip of the tongue in young, and (2) disease of the base of the tongue in old animals.

The affected oxen can chew but little or not at all. They certainly attempt to take food but chew slowly and let fall most of what is grasped; on the other hand they can swallow fluids. Salivation soon sets in and the manger is often covered with foamy saliva. The tongue feels hard and rigid, but is smooth and not painful on manipulation.

In well-developed cases and in full-grown cattle the prognosis is unfavourable. Such animals had best be slaughtered. Under opposite circumstances something can be done. Early treatment in young animals is often completely successful. Older animals are usually incurable. As in actinomycosis, iodide of potassium is given in full doses and the tongue is painted with tincture of iodine, if necessary after scarification.

ACTINOMYCOSIS OF THE TONGUE. GLOSSITIS ACTINOMYCOTICA.

This disease is very common in cattle, and a few cases in horses and swine have been recorded. Certain localities seem particularly affected. France appears nearly exempt, but Russia, Denmark, America and North Africa furnish numerous cases. The disease is fairly common in Germany, 7.2 per cent. of the total number of oxen slaughtered in Berlin showing it.

The changes in the tongue consist in chronic proliferation of the connective tissue, which exhibits numerous granulating centres. In these the specific fungi are embedded. Sometimes the centres suppurate. The swellings and abscesses usually rise above the general surface of the tongue and are readily visible. Sometimes

the appearances consist in ulceration of the base of the tongue just in front of the swelling. Though such lesions are usually due to actinomycosis their true nature is not always recognised.

Appearances and Progress. The tongue gradually becomes thicker and larger, especially at its base, and, on account of its stiffness, feeding is rendered difficult, whilst in swallowing, the head and neck are abnormally extended. Salivation frequently exists, and difficulty in breathing may appear, particularly during mastication and swallowing. At the same time respiration becomes audible, whistling or rattling. These symptoms slowly becoming aggravated, the mouth is examined, and the tongue found thickened, its base being unusually stiff and hard. The veins are abnormally large, and the surface has a dark blue colour, as in strangulation, but acute inflammatory symptoms (pain and oedema) are absent. Hard swellings, which vary from the size of a pea to that of a pigeon's egg, are occasionally visible on the surface, and may show signs of erosion. They are best felt when the tongue is allowed to glide through the hand. Zschokke states that these swellings lie immediately beneath the mucous membrane, and can thus be readily detected. Not infrequently they are of a distinctly yellow colour. In other cases the tongue is simply increased in size. After a time the submaxillary lymphatic glands swell, and at a later stage oedema is present. The difficulty in swallowing prevents the animals taking anything but fluid nourishment, and slow wasting ensues.

Henschel and Falk at the Berlin slaughter-houses saw actinomycosis of the tongue appearing as white or yellow hard swellings, varying in size from a pin's head to a bean, sometimes lying in the mucous membrane, sometimes in the deeper tissues. The disease always started from the lower (anterior) border of the dorsum. They think that a certain connection exists between the localisation of the disease and the manner in which oxen gather their food. In grazing, the tongue is rotated and passed sideways round the blades of grass. Injuries are thus inflicted which afterwards allow the entrance into the tissues of actinomyces or of particles of food. Of the total animals slaughtered, 9·1 per cent. showed such excoriations, and 7·2 per cent. were affected with actinomycosis.

Treatment. Prognosis is unfavourable, and animals fit for the butcher had best be slaughtered. Fluid food is indicated. Although hitherto looked upon as incurable, some cases recover after local scarification and the use of iodine. Bassi, Thomassen, Ostertag, and others recommend iodide of potassium internally, 1 to 2½ drachms in a quart of water for six succeeding days. This is said, however,

to have occasionally produced a kind of poisoning. Actinomycosis may not only be checked but absolutely cured by deep scarification and painting with iodine solution (Thomassen, Ostertag, and others). Of 100 cases Strebel claims to have completely cured one-third and to have so improved others that they could be successfully fattened ; only 50 per cent. he regards as incurable. To these belong the advanced cases, and those in which the root of the tongue is principally involved. Where the point and middle alone are invaded, the prognosis is much more favourable, for in these parts deep incisions may be made without danger.

Dressing with tincture of iodine may be carried out two or three times a day after eating. Ostertag, however, assigns much importance to careful application of the drug ; after laying open all swellings, he applies the tincture personally, using a stiff brush. The application is renewed once a week. Bass noted a relapse after iodine treatment. The later observations of Thomassen, Nocard, Ostertag, and others give a high value to the administration of iodide of potassium internally, and the local use of tinct. iodi. Under any circumstances it is better, when dealing with an infectious disease, not to place too much reliance on complete or lasting recovery, and as soon as sufficient improvement is declared to prepare the animal for the butcher. Such animals fatten most readily on distillers' and brewers' grains, which make only slight demands on their masticating powers.

PARALYSIS OF THE TONGUE (GLOSSOPLEGIA).

Inflammatory processes may interfere with the movements of the tongue ; but its paralysis depends on injury to the hypoglossal nerve, which supplies with motor filaments the collective muscles of the tongue, and most of those of the hyoid bone.

Wounds, abscesses, or inflammatory processes may affect the nerve at some point of its course, or at its origin on the inferior surface of the medulla, and thus produce glossoplegia. Kater saw one-sided paralysis occur in a foal which three months before had been wounded in the throat with a knife. On the left side the muscles of the tongue had so completely disappeared that at that point the upper and lower coverings of mucous membrane were in contact. In the case of a horse which had first suffered from left-sided, and afterwards from general paralysis of the tongue, Hallander discovered on the left side of the medulla a sarcoma which had originated in the guttural pouch. This paralysis is also seen during

severe infections, like contagious pleuro-pneumonia of the horse (see Cadiot and Dollar's "Clinical Vet. Med. and Surgery"). In central paralysis both nerves usually suffer, and, of course, both sides of the tongue, for the two hypoglossal nerves arise very close together. In the horse paralysis of the tongue sometimes accompanies acute meningitis, or cranial dropsy. But every case of double-sided paralysis is not necessarily central. Diplegia occurs in horses whose tongues have been roughly handled, and where both nerves have been injured. In dogs double-sided paralysis is regularly observed during rabies, but it also appears without any preceding illness, and is sometimes accompanied by masticatory facial paralysis. Here the cause is probably central. A somewhat similar paralysis of the tongue in a dog, accompanied by rather extensive disease of the brain, is thus described by Frick :

The dog, which was about five to six years old, usually stood with its back arched, and with the limbs drawn under the body ; there was general quivering of the entire surface. The eyes were cloudy and watery ; tears ran over the cheeks and fluid from the nostrils. Long threads of tenacious saliva hung from the mouth. There was a weak, rather frequent, cough. The rectal temperature was 103.2° F. Examination of the cavity of the mouth showed that about 1 to 1½ inches of the free end of the tongue was relaxed and incapable of voluntary movement. When the affected part was thrust backwards the animal could not return it to its normal position. The soft palate hung flaccid and was not under control. Food was fairly well taken and swallowed. The animal eagerly took water, which, however, at once ran out of its mouth. To overcome this difficulty a rubber tube was passed into the œsophagus, and water administered by pouring it into a funnel attached to the free uplifted end. After a short time, however, the water was returned, part being lost through the mouth and part passing down the trachea, causing the animal to cough.

Diagnosis. Paralysis of the soft palate, point of the tongue, pharynx and œsophagus.

The dog was removed by the owner without undergoing treatment.

Jürgens thinks that numbers of the observations published in veterinary literature as glossoplegia really relate to inflammatory affections, but paralysis of the tongue may certainly result from acute inflammation of that organ.

The symptoms of one-sided paralysis are displacement of the tongue and difficulty in mastication and deglutition. In double-sided paralysis both acts become nearly impossible, particularly the latter. The tongue generally hangs from the mouth. In protracted cases the muscles atrophy, though, of course, in single-sided paralysis only those of the paralysed side suffer.

The disease must not be confounded with the so-called "protrusion," where the tongue is voluntarily lolled out of the mouth.

Paralysis is shown by distortion and inability to retract the tongue.

Prognosis is generally unfavourable in double-sided paralysis. The animals cannot be fattened, and therefore, if the case is persistent, it is better to slaughter. Monoplegia is of little consequence, as the animals can still feed well.

Treatment can do little. Should the disease be caused by external injuries, these must be dealt with on general principles, otherwise one can only await developments or slaughter. In fat animals the latter course is preferable, as condition is rapidly lost.

RANULA.

Ranula is commonest in dogs and cattle, though it also occurs in the horse. Under the point of the tongue in the *frænum linguæ*, a long roundish swelling develops, which may attain the size of a hen's egg. It is greyish-yellow, soft, and not inflamed. When opened, a yellow, jelly-like fluid escapes, and the walls collapse. The swelling, if of any considerable size, interferes with feeding and produces salivation. In man the voice at times assumes a harsh, croaking tone, hence the German name "*Froschgeschwulst*" (Frog swelling). The pathological cause has not been determined even in man. It was thought to be due to occlusion of Wharton's duct, but this is generally found to be clear. More recently it has been regarded as stoppage of a mucous duct (retention cyst). The condition in the dog is no better understood. One should beware of regarding every swelling in or near the *frænum linguæ* as ranula, only the true cyst deserving this title. Marked swelling of the loose sublingual connective tissue is often mistaken for the condition in question. Such swelling frequently accompanies cellulitis at the base of the tongue or in the pharynx. A flaccid swelling containing blood-stained or yellowish fluid is then found under the tongue. In cattle the *frænum* may be swollen from actinomycotic proliferation.

Prognosis is favourable, though simply laying the cyst open is ineffective as it always fills again. But this can easily be prevented by removing the thin wall with scissors and forceps. Ellinger has employed injections of pilocarpine with success. Stockfleth has described as ranula in cattle an entirely different condition, which takes a much more troublesome course, and must be regarded as a malignant inflammation of the submaxillary lymph glands (compare with affections of lymph glands). Hohenleitner states having seen two cases of ranula caused by actinomyces. The ranula disappeared after painting with iodine, though stiffness of the tongue persisted.

FRACTURE OF THE HYOID BONE.

On account of its sheltered position, fractures of the hyoid bone are rare, but have nevertheless been observed. In horses and cattle they are produced by thrusts with the horns, and blows with the feet, or even by violent traction on the tongue. In dogs they result from the animal being roughly seized by the throat, as is sometimes done by the police in securing stray animals.

The Symptoms comprise salivation, prolapse of the tongue, difficulty in eating and especially in swallowing, accumulation of food in the mouth and swelling in the throat. In complicated fractures there may also be bleeding from the mouth, possibly of a severe character. Crepitation on moving the tongue can seldom be detected.

Union of submucous fractures is usually complete in four weeks. But it not infrequently happens that fragments of bone perforate the mucous membrane. Intense inflammatory swelling then develops, which may quickly prove fatal (Herraud); or mastication and swallowing may be interfered with, and death occur from inanition, or the patients may require to be slaughtered. Fatal bleeding sometimes results from splinters of bone injuring neighbouring blood-vessels. Rupperecht relates that the broken hyoid of a horse perforated the guttural pouch and caused death by lacerating a large vessel. Asphyxia caused by such bleeding occurring into the larynx and trachea is spoken of by Bolle. But even cases complicated by exfoliation of large pieces of the hyoid may recover in from six to eight weeks, as Schade's experience shows.

Treatment in simple fracture is confined to supplying suitable food which must be easily digestible and require little mastication. At the commencement, water may be given per rectum, especially if deglutition is difficult, and soluble nourishment may be administered in the same way. In complicated cases the wound must be frequently cleaned. Should the skin be wounded by perforating fragments (an exceptional occurrence), ordinary antiseptic treatment must be adopted, and loose pieces of bone removed.

NEW GROWTHS IN THE TONGUE.

Whilst carcinoma of the tongue is common in man it is comparatively rare in domesticated animals, but the following growths have been observed:

In young dogs, calves, and horses, numerous papillomata are not uncommon. They vary in size from a pin's head to a walnut, and

are usually partially macerated in the saliva. The significance of these growths in young animals has not been explained. Frick saw a young sporting dog whose tongue was thickly coated with such growths. The condition is seldom of importance, does not interfere with eating and disappears spontaneously. Treatment consists in snipping off the growths with scissors or enucleating them. Fowler's solution of arsenic internally is useful.

Fibromata, sarcomata and carcinomata are seen in oxen and horses. They only receive surgical treatment when in or near the tip of the tongue, whence they can be removed by amputation. When seated further back treatment is useless, and the patient had better be slaughtered.

Mucoid cysts have frequently been seen at the base of the tongue in horses. In many cases they have caused no complication, and have only been discovered after death apparently from an epileptiform fit. In other cases they have caused difficulty in swallowing, breathing and mastication. Pedunculated cysts may be removed with the *écraseur*; the flatter kinds are laid open and their interior destroyed with the cautery or by dressing with tincture of iodine.

(3.) FRACTURE OF THE PREMAXILLARY BONE.

Such fractures are caused by falling or running against obstacles; in horses by kicks, in dogs by blows. Sometimes the nasal process alone breaks; sometimes the alveolar portion with one or more incisor teeth is involved; sometimes the bodies of both bones are broken.

Diagnosis is based on the painful character of the swelling, and on the result of examination of the bone, which lies almost immediately under the skin. Transverse fractures of the body of this bone produce results similar to those of the body of the under jaw; the upper incisor teeth and the alveolar margin of the bone appear movable, or are more or less displaced backwards. The upper lip often hangs down obliquely, so that on casual examination this injury might be mistaken for facial paralysis. So long as the fracture is confined to a single alveolus or to the nasal process, it heals rapidly and completely. Transverse fractures of the body give greater trouble, especially when the alveolar margin and the incisors are movable, or when a complicated fracture exists.

Treatment aims at fixing the fragments in position with wire in the same way as in the lower jaw. In complicated fractures strict antiseptic precautions must be observed. In some cases the incisor

teeth, which have been dislocated backwards, can only be replaced in their normal position after the lapse of some time, and by exercising considerable force. But as soon as they are brought into position, so that the upper and lower teeth are in contact, the movements of mastication usually suffice to complete replacement. In horses transverse fractures of the premaxillary bone just behind the alveolar process have often been seen: in one case the upper incisors had all been thrust downwards and backwards in consequence of the animal falling on the mouth. Reduction can often be effected, even several days after the accident, by applying a steel hernia-clamp, or by using as a lever the handle of a hammer. Sometimes strong pressure with the thumbs is sufficient.

(4.) INJURIES OF THE INTERDENTAL SPACE.

The interdental space is that portion of the jaw which intervenes between the corner incisor and the first molar tooth. The bone here presents a more or less sharp border, and is covered with periosteum and thick mucous membrane. On this part the pressure of the bit falls. The bit usually rests on the tongue and edges of the lips, but the action of the reins presses it against the jaw, and thus, especially in riding-horses, produces wounds. The more severe the bit, and the lower it is fixed, the more easily this happens. Such injuries are also more frequent with a high and sharp conformation of the bone, a thin tongue and relaxed lips, and with riders whose hands are heavy.

Unfortunately, wounds are often discovered only when the jaws are considerably swollen. Injuries to the interdental space are very common in the army after general manœuvres, and when cavalry ride great distances without veterinary superintendence. Under such circumstances the mouths require to be examined as regularly as the backs and saddles. In tender-mouthed horses leather or rubber covered bits prevent this injury and should be used for some time after healing; but as long as wounds exist they are of little service.

The simplest injury consists in abrasion of the mucous membrane covering the interdental space. The epithelium being removed by the rubbing of the bit makes the mouth sensitive and the horse troublesome for a few days.

Should the force be greater, the mucous membrane will be bruised or wounded. Infection and suppurative periostitis occur, the border

of the bone appears enlarged and the mucous membrane inflamed and thickened. In other cases the periosteum is lacerated, exposing the bone, and sometimes fracture is produced. In severe bruising by the bit, suppurative otitis and superficial necrosis with exfoliation are common results.

The careless use of severe bits ends in disease of the periosteum or of the bone. Sometimes periostitis goes on to the formation of exostoses, and occasionally the inflammatory process, complicated by pus formation, extends to the jaw producing suppurative osteomyelitis. This is followed by marked enlargement of the bone towards its body, where later an abscess may form. Necrotic portions of bone, as large as a finger, may be discharged. Though in such cases recovery is naturally slow, it is nearly always complete, and no permanent injury is left.

Symptoms. Attention is often first directed to an abrasion of the mucous membrane by the excitability of the horse when reined in. Bruises are recognised by the local swelling, redness and pain; wounds are directly visible. The parts are best examined by introducing the forefinger into the mouth; and should pain, swelling, or laceration of the membrane be detected, the diagnosis can be confirmed by inspection. Periostitis can only be discovered by touch, otherwise it often remains unnoticed, the horse's pulling being assigned to bad temper, either on its part or on that of its rider. Moderate pressure on the inflamed spot produces marked pain. Wounds in the mucous membrane and necrosis of the bone are generally offensive and easily detected with the finger or a metallic probe. Osteomyelitis is recognised by swelling of the bone, usually extending from above downwards towards the lower edge of the jaw. When an abscess breaks at this point, fistula is a common sequel. The probe often passes from the lower edge of the jaw right into the mouth. Salivation and painful mastication, though they sometimes occur, are not essential characteristics.

Treatment must be based on the anatomical changes. If the parts are merely abraded, it will be sufficient to rest the horse, or to use a rubber bit, or nose-band, in place of a more severe bit, until the epithelium has again grown. In wounds of the mucous membrane, rest or absolute avoidance of bar bits is necessary. The parts must be cleansed after each meal, and the horse muzzled or tied up. The wound should subsequently be treated according to its character. Immediately the bone or periosteum begins to suffer, the horse must be rested. In uncomplicated periostitis recovery usually follows this treatment in a week or ten days; but in fracture, or suppurative

ostitis with necrosis, improvement will only occur after removal of the necrotic bone. This can readily be effected with dressing forceps, after slightly enlarging the wound in the mucous membrane. Afterwards the wound must be thoroughly cleansed and disinfected, and to prevent food particles entering, it should be stopped with a tuft of iodoform gauze. In caries of the lower jaw, Greiner injects the fistula with concentrated solution of lactic acid, and then introduces tampons soaked in the same fluid. The wound requires cleansing after each meal, and treating as above indicated. In some cases good results follow the use of a pointed cautery.

(5.) DISEASES OF THE TEETH.

This section will take cognisance of all pathological conditions of the teeth, and of all irregularities in the conformation of the mouth, which interfere with mastication. Without this wider knowledge abnormalities of the teeth cannot be understood, nor can a reliable diagnosis be made. Diseases of the molars are most important in herbivora, because the molar teeth perform the whole duty of grinding the herbage, while the incisors only cut it. The dental disorders of vegetable feeders will, therefore, first receive attention.

The clinical appearances, although varying in the different conditions, generally show marked agreement. In horses (to which we now more particularly refer), the following symptoms are usually present :—

(1) Deliberate cautious mastication, subject to sudden interruptions and rolling of the tongue, the head being held on one side.

(2) Dropping of food from the mouth ; balls of hay are found in the manger ; in popular phrase the animal “quids” its food.

(3) An important symptom is the presence of food in the mouth, generally in the cheek, a considerable time after eating. Grinding the teeth when no food is in the mouth is also significant.

(4) At a later stage wasting and loss of strength. In cattle epileptiform convulsions have been seen as a result of dental disease. In dogs salivation should always draw attention to the state of the mouth, and particularly of the teeth.

Alveolar periostitis is the most common dental disease in animals, and always gives the mouth an extremely offensive smell.

Immediately any such symptoms are present, the mouth, and especially the teeth, should be thoroughly examined. In some horses, irregularities of the teeth can be detected through the thickness of the cheeks by palpation from without. Sometimes the bone swells

and fistulæ form. The incisors are easily inspected, but examination of the molars requires certain precautions varying in the different classes of animals. Deviation of the teeth from their absolute or relative positions likewise points to disease. With the assistance of a mouth gag (Fig. 20) and the electric torch (Fig. 272A) the crowns of the molars can be inspected in horses and cattle.

Diseases of the teeth may be clinically divided into four groups :

- A. Irregularities in development.
- B. Irregularities in wear.
- C. Diseases of the tooth proper.
- D. Diseases of the alveolar periosteum.

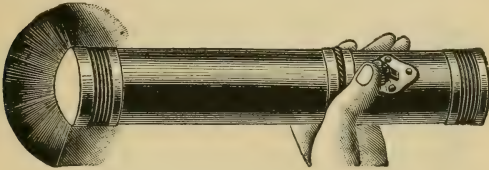


FIG. 272A.—Electric Torch.

(A) IRREGULARITIES IN THE DEVELOPMENT OF THE TEETH.

EXTRA OR ADVENTITIOUS TEETH (POLYODONTIA, HYPERDENTITION).

Kollmann states that in man during foetal life more enamel germ is sometimes formed than is required for the normal number of teeth, and that this determines the production of supernumerary teeth. Kitt looks on hyperdentition as a result of atavism, and points to the fact that in former ages foals had more teeth than at present. The same theory explains the appearance of the pre-molars in the horse, whose ancestors (*Hipparion*, &c.) always had four pre-molars. Kitt describes as a typical hyperdentition the apparently purposeless excess of teeth, an example of which is cited by Goubaux, where a certain horse had double the normal number of incisors. Günther, Stockfleth, and others have noted supernumerary molars. Their commonest situation seems to be behind the third molar, but they may lie alongside the normal teeth, being either in contact with the tongue or cheek. At times milk teeth may be retained by becoming fixed between their permanent successors.

Supernumerary teeth are seen in most of the domestic animals, supernumerary incisors, canines, and molars all being represented, the latter most frequently. A regular series of such observations

in horses and oxen has been compiled by Morot, and in the dog by Sussdorf.

Excess teeth seldom cause trouble until, by continued unopposed growth, they come in contact with and wound soft tissues. Röll and Dieckerhoff saw cases where a tooth in the lower jaw had become so long as finally to penetrate the opposite bone. The nasal cavity may even be pierced, and an offensive discharge produced. Möller records two such cases. Supernumerary molars, when on the inside of the row, are apt to wound the tongue, and, when on the outside, the cheek. Walther speaks of two accessory molars in the horse which appeared, one on the inner side of each of the third upper molars. The horse had difficulty in chewing. Möller



FIG. 273.—Supernumerary tooth (horse).

saw two cases where a supernumerary tooth was present on the inner side of the fourth upper molar (Fig. 273). Both teeth suffered from alveolar periostitis, penetrated the maxillary sinus, and produced chronic nasal discharge. In another case the extra tooth was on the inside of the third pre-molar, and interfered with mastication.

Treatment consists in removing or shortening the offending molar. Extraction is difficult where the tooth stands close to another, and therefore cannot be grasped. In these cases it may either be shortened or punched out. Such teeth may be removed by using forceps with sufficiently thin jaws to pass between the diseased tooth and its neighbour. In the front of the mouth the two teeth may sometimes be thrust asunder with a strong chisel.

IRREGULARITIES IN REPLACEMENT OF THE TEETH.

Occasionally the milk teeth remain fixed in position, and cause the permanent teeth to grow irregularly. Such milk teeth may be removed with ordinary forceps, though Günther's are preferable (Fig. 298). It should be noted that the milk tooth is always in front, the permanent behind. The incisor teeth are sometimes absent in dogs, especially in such as have suffered from severe attacks of some infectious disease during very early life. It seems possible that under such circumstances the germ of the permanent teeth

may have undergone atrophy. The eruption of the molars seldom gives rise to trouble, though at times severe pain accompanies the process, and soft food may be required. Occasionally, however, the animal loses condition to such a degree as to necessitate operative interference. Frick removed six temporary molars from a foal's mouth; they had remained fixed on the erupting teeth like caps, and during mastication continually injured the gums and cheeks. The animal's appetite and condition immediately improved after the operation.

DISPLACEMENT OF THE TEETH.

Molars may become displaced in consequence of disease of the alveolar periosteum and loosening of the teeth. This condition will be noticed later. Abnormalities occur in development; one or another of the permanent incisors, instead of appearing in the site of the deciduous tooth, sometimes makes its appearance at a point further back, and wounds the tongue. Stockfleth mentions a case of this kind.

In horses an incisor is sometimes rotated on its axis, the convex surface being turned inwards, or it lies horizontally, and grows beyond the lips, injuring the animal's appearance. The molars may be similarly displaced. Kitt describes a mouth in which the first molar lay with its crown alongside the outer aspect of the second and fourth, whilst its root projected from the jaw on the inner side at a point about an inch and a half below the alveolar ridge.

Kitt ascribes such deviations from normal position either to temporary or permanent want of space at the time the tooth appears, or to abnormal conformation of the mouth or incidence of pressure. A milk tooth may thus give an abnormal direction to a permanent tooth just developing, or this abnormal direction may exist from the first.

False position, due to irregular development of the jaw, may be considered under this heading. Either jaw may be affected. If the upper is too long (*Prognathia superior*), or the lower too short (*Brachygnathia inferior*), the so-called "overshot jaw" is the result; whilst an opposite conformation produces "undershot jaw." These variations result from faulty development of the bones, and are often accompanied by corresponding changes in the molars. In undershot jaw the lower rows of molars are displaced anteriorly so that the first lower molar projects beyond that of the upper jaw, whilst the last upper molar does not come in contact with its fellow of the lower jaw. In overshot jaw the case is reversed. The teeth consequently

either partially or entirely escape wear, and thus become too long and impede mastication. The nose, or even the entire head, may be distorted, producing displacement of the teeth. This is termed by Gurlt campylorhinus (Fig. 279). Leisering saw such a case during life. Dose noted a peculiar abnormality in a cow. The incisors stood in pairs, one behind the other. Although the animal was three years old, no teeth had been shed. The under jaw was deformed, and Gurlt considered this to be the real and primary cause of the peculiarity.

When slight, these changes are of little importance, but immediately they become pronounced they produce various undesirable results. The animal has difficulty in grazing, can no longer tear off the short grass, and where the incisors are much affected mastication even of cut food may prove difficult and painful. If the molars fail to correspond, the grinding surfaces wear away unevenly, and the overlapping part grows until it wounds the opposite gum or even the palate, and thus produces pain in chewing. Deviation of the axis of the tooth in either a backward or forward direction, is continually aggravated by mastication, which tends still further to thrust the tooth out of position and is apt finally to produce alveolar periostitis.

Schrader saw a horse in which the first left upper molar was immediately behind the tush, while the second lay at the inner side of the third, so that the first molar was separated from the others by a space of 2 inches. The first two lower molars had grown into this space and perforated the palate, and in drinking, the water passed through this aperture and was discharged by the nostrils. The horse, being much wasted, was slaughtered.

Too great a space between the teeth is at once abnormal and injurious, especially in the case of the molars. The crowns of the teeth should stand close together, so as to afford mutual support, and prevent food entering the interspaces. Where intervals occur food is driven into them, penetrates even the alveoli, producing inflammation and loosening the teeth. Such alveolar periostitis is very common in old animals.

Treatment consists in shortening or removing the offending tooth. In young animals too much of the tooth must not be removed at once, as the pulp cavity may be exposed, and alveolar periostitis set up. Where intervals occur between the teeth the evil is palliated by giving soft food, so as to lessen the need for mastication, or by extracting one or two teeth.

(B) IRREGULARITIES OF WEAR IN THE TEETH.

In the horse's under jaw the rows of molars form two almost straight lines, which posteriorly diverge slightly. In animals of average size the first right and left molars lie about 2 inches, the last about 4 inches, from each other. In the upper jaw the space between the two rows (which are bowed outwards) is considerably greater, the two first molars standing about 3 inches, the last molars about 4 to $4\frac{1}{4}$ inches from each other. At the boundary between the pre-molars and molars the cross measurement in the upper jaw is about $4\frac{1}{4}$ to $4\frac{3}{4}$ inches, in the under jaw about $3\frac{1}{8}$ inches. It will thus be obvious that during rest the grinding surfaces of the upper and lower rows do not cover each other; the upper row overhangs

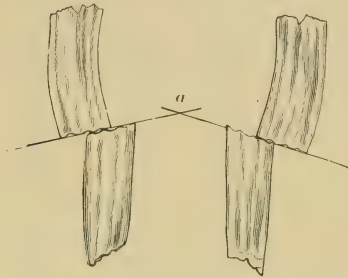


FIG. 274.—Normal position of the molars in the horse.

the outer edge of the lower; while, on the other hand, the inner edge of the lower row projects farther inwards than that of the upper (Fig. 274). Moreover, the grinding surfaces, when viewed from in front, are inclined to the horizontal, their outer borders being $\frac{3}{16}$ to $\frac{3}{8}$ of an inch lower than their inner. If the lines of the grinding surfaces are prolonged, they meet in an obtuse angle below the palate (Fig. 274). Baume places the teeth of the horse in a class between those which grow continuously, and have an open pulp cavity, and those like the teeth of men and carnivora, the pulp cavity of which is closed, and which grow from the root.

The ox's molars differ from those of the horse in having a much rougher grinding surface. The edges of the folds of enamel are prominent, forming, even in normal teeth, quite sharp points. The lower rows of molars lie almost parallel with each other, or, at most, are slightly bowed outwards. Sometimes the upper and lower rows of molars altogether fail to coincide or to cover. In many cases,

when seen from in front, the outer edges of the lower molars are at the same height as the inner edges of the upper. The grinding surfaces are inclined as in the horse. Günther states that the normal rate of wear, which in herbivora is very considerable, amounts to about 2 mm. (nearly one line) per year. In consequence of this continued wear, the grinding and cutting surfaces should eventually attain perfect contact. But where they do not, certain areas are insufficiently worn, and grow abnormally fast (*Exsuperantia dentis*, Kitt), while certain others wear too quickly. Hence arise the following irregularities :—

- (a) The angular or sharp mouth.
- (b) The shear-like mouth.
- (c) The wave-formed mouth, where the row of teeth, seen from the side, appears undulatory.
- (d) The step-formed mouth, where, from similar irregular wear, the row is composed of alternate high and low teeth.
- (e) Premature wear of the teeth.
- (f) The smooth mouth.

THE ANGULAR OR SHARP MOUTH, THE SO-CALLED PROGNATHOUS JAW.

Under ordinary circumstances mastication causes general wear of the entire grinding surface of the molars, but if any part fails to be worn, that portion will become too long. Owing to the peculiar relations of the two jaws, the points which generally escape wear are on the inner side of the lower row and on the outer side of the upper. Either single teeth, an entire row, or even several rows, may be involved. If the two rows do not terminate at the same point, the upper molar being too far forward, or the first lower molar too far back, the unopposed points will continue to grow until their sharp elongations may injure the opposite gum.

Causes. This irregularity may be caused by a narrow formation of the lower jaw, as was shown by Defay, and later by Günther and others, though such formation is not the only cause; otherwise the ox, which very rarely exhibits the condition, should be a frequent sufferer. It is assisted by limitation of the movements of mastication, which in its turn is said by Lorge to be dependent on faulty development of the muscles of the jaw. In chewing, the ox moves the jaw laterally through a wide angle; hence, although its upper and lower rows of molars do not coincide, it very seldom suffers from sharp edges. As soon as sharp edges form on the teeth, the

inside of the cheeks may be wounded. The further limitation thus placed on movements of the jaw aggravates the production of sharp

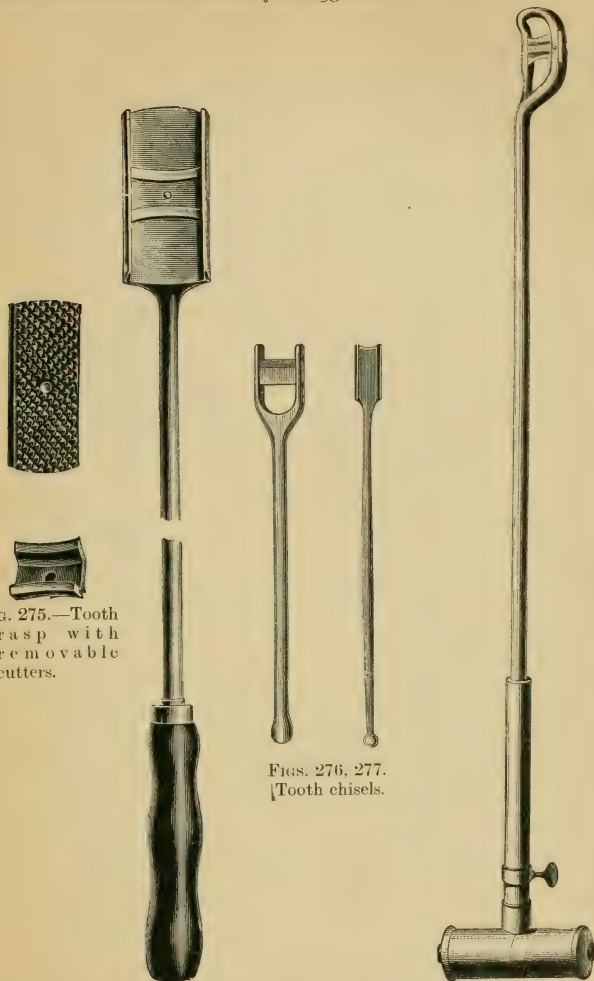


FIG. 275.—Tooth rasp with removable cutters.

FIGS. 276, 277.
Tooth chisels.

FIG. 278.—Tooth cutter. The cutter is placed in position against the protruding tooth, and the telescopic weighted handle is then rapidly slid forwards until arrested by contact with the end of the stem. The shock produced causes the projecting piece of tooth to spring off.

edges, and the mischief increases. It is easy to operate on the sharp edges and points of the teeth, but this does not remove the cause, and the malady is liable to recur. The sharp edges of the lower

teeth lacerate the tongue, while those of the upper injure the cheek. These injuries may eventually induce general wasting and loss of power. Such a condition is seen especially in old horses, seldom in other animals.

Symptoms. The animal feeds badly, chews slowly and cautiously, and holds the head to one side. Food is often dropped from the mouth into the manger; portions also remain between the teeth and cheeks; while movements of the jaws or tongue are as much as possible avoided. Wounds of the mucous membrane produce copious salivation. Jessen remarked that this condition was formerly often overlooked; but that its importance is apt nowadays to be over-estimated, and the diagnosis of "sharp teeth" is sometimes used as a cloak for ignorance. Irregularities, however, frequently produce no mischief, and can only be regarded as causes of imperfect mastication when they occasion wounds of the tongue or cheeks. Unless where very marked, they are unimportant in young animals.

Treatment. Sharp points or edges can either be removed with the rasp (Fig. 275) or one of the several forms of chisel (Figs. 276, 277 and 278). If necessary, perfectly efficient instruments can be made from an ordinary foot-rasp. Large projections require the use of the chisel and mallet or hammer. In the case of the back molars the chisel must be used with caution, so as to avoid injuring soft structures. The blow must be sharp but short; while, to prevent the chisel travelling too far forward, the left hand, in which it is held, can be rested against the incisor teeth. The skilled practitioner can dispense with instruments having rounded guards near the cutting edge, and also with Brogniez's "odontriteur," a chisel in which the blow is produced by an iron bolt sliding on the handle. The rasping and chiselling of the teeth sometimes produce their good results indirectly, by making one or more teeth sensitive, and thus throwing the patient off its feed, time is given for recovery from gastric affections.

In old horses, chewing on one side of the mouth sometimes shortens the incisors of that side. This condition, described by Günther as "oblique mouth," seldom causes trouble, but is interesting because often associated with irregular wear of the molars.

SHEAR-LIKE MOUTH.

Shear-like mouth consists in a considerable increase in the obliquity of the wearing surfaces of the molars. Their outer edges in both jaws are too low, the inner too high, so that the wearing surfaces,

if prolonged, would meet in an acute angle above the palate. In other words, the crowns lie not over, but alongside, one another, so that the mouth resembles that of a flesh feeder (Figs. 279 and 280). The rows of teeth, therefore, do not grind, but cut, meeting one another like the blades of a shears, in which the inner blade is formed by the lower molars, the outer blade by the upper. When confined to single teeth, this change most frequently affects the fourth molars, because they are more liable to lateral displacements; but, as a rule, one whole row is affected, constituting simple shear mouth; occasionally both sides suffer (double shear mouth).

The condition is brought about thus: The inner edge of the lower molars and the outer edge of the upper are not worn away;



FIG. 279.—Left-sided shear mouth
(from a photograph).

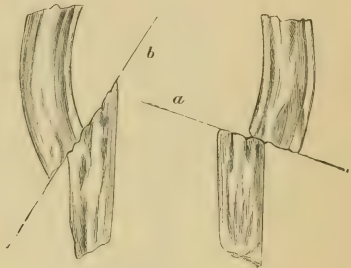


FIG. 280.—Grinding surfaces
in shear mouth, in normal mouth.

both continue to grow until the former meets the hard palate, while the latter injures the gums of the lower jaw. Coupled with impaired mastication, such wounds prevent the horse either taking or chewing food. The overgrown teeth sometimes penetrate the bone above, and the hard palate may even be completely perforated. The side thrust on the teeth loosens them, while wounds of the gum are apt to produce inflammatory changes in the alveolar periosteum. Hence "shear mouth," especially in old horses, generally produces alveolar periostitis.

Its causes are the same as those of angular or sharp mouth. A narrow jaw and limited movement are notable predisponents. It is unnecessary to discuss the correctness of Lorge's supposition that the muscles of the jaw are imperfectly developed; or Günther's, that the affection is due to variations in hardness of the molars,

Esser saw shear mouth result from the articulation of the jaw being wounded, lateral movement in one direction being shortened, and irregular wear thus induced.

Prognosis depends on the degree of development, condition of the teeth, and existing complications. The earlier stages escape notice ; it is only when chewing becomes difficult that its presence is suspected. Provided the teeth are still sound and firm, temporary relief may at all events be given ; but where they are loose, or alveolar periostitis has already set in, the chances of recovery are slight, and in long-standing cases cure is impossible.

Treatment was formerly confined to removing the sharp edges with the rasp or chisel, and lightening the work of mastication by giving soft food. Even nowadays nothing more can be done if the teeth are loose or shear mouth is moderately developed. But where the patients are young and valuable, and the teeth still firm, relief may be assured, at least for some time, by removing the projections with tooth shears. Möller operated on several cases in this way, and the animals immediately afterwards were able to take their food and masticate quite satisfactorily. If several teeth have to be shortened, the horse must be cast, but the operation is not difficult, and Möller more than once operated on double shear mouth in a quarter to half an hour, and had most excellent results. As to the use of the shears, see section (D) hereafter.

THE WAVE-FORMED MOUTH.

The wearing surfaces of the several molars on each side above and below are normally of similar height, and form a plane surface ; but variation of this plane produces the wave-formed mouth. It is generally bilateral, the fourth lower molar being the shortest, the corresponding upper tooth the longest in their particular rows. The molars in front and behind these become respectively longer or shorter. In the lower jaw they are usually too long, in the upper jaw too short. Sometimes the state of things is reversed.

This form of mouth usually depends on unequal durability of the individual teeth, and sometimes on disease of the alveoli. Slight inequalities cause little discomfort ; but when well developed, and especially if the alveoli are involved, mastication is greatly impaired, and the sharp points and edges wound the opposing soft parts. Certain teeth may be worn down level with the gum, and mastication made exceedingly painful. The disease occurring in early life is especially serious, as it becomes aggravated with age.

Treatment. Sharp points and edges must be removed. Excessively long teeth which injure soft structures should be shortened or extracted; and the diet should consist mainly of crushed food and slops.

THE STEP-FORMED MOUTH.

This irregularity is closely allied to the foregoing. The only difference between them is that the neighbouring molars vary in height, not gradually but suddenly, a short one being followed by a much longer one, or *vice versa*. The same cause, viz., unequal hardness, seems at work here. The condition may be due to some unknown constitutional peculiarity, as evidenced by its attacking both sides of the mouth. The spaces resulting from loss of teeth are often responsible for its production.

The prognosis depends on the degree and extent of the irregularity. Mastication is usually more impeded by this than by the wave-formed mouth, because lateral movement of the jaws is here more difficult. The disease is gravest where the animals are young, the soft tissues wounded, or where several teeth have been lost.

Treatment is merely palliative. Soft food will assist mastication. The longest teeth must be reduced or removed. The crowns can be shortened with Möller's tooth shears. This is preferable to extraction, which often presents great difficulties on account of want of room, whilst the use of file and chisel demands much time and care.

Möller's shears (Fig. 281) have been frequently varied, but not much improved. The central screw lying between the limbs of the instrument ensures great power without disturbing the position of the instrument. Every part must be fashioned very strongly and carefully of the best steel, for, owing to the immense power of the screw, it might otherwise break or bend. With quiet horses one or more front molars may be cut without previous casting. But it is better to cast the patient when it is high-couraged or troublesome, or when several teeth or any of the back molars are to be dealt with. After inserting a rather large mouth gag and drawing the tongue away from the part to be operated on, the shears are adjusted on the tooth to be shortened, and the screw turned, while the instrument is held by one or two assistants. After a few turns, made as quickly as possible, the desired portion of the tooth will spring off with a loud noise. At this moment the horse usually makes a movement with its head, but, as the shears are already free, this is of no importance. Möller has cut many strong upper molars without ever having an accident. The tooth breaks off smoothly. In old horses, it may happen that the movement of the head loosens the tooth, and it comes away with the shears, affording, however, the desired relief. Most difficulty is met with in back molars, and where the sides of the teeth have been worn away obliquely. The gag must be wide enough to allow the open shears to be easily introduced. When the shears slide off the sides of the teeth, Möller's tooth screw

(Fig. 283) may preferably be employed. In this instrument the power of the screw acts directly on the cutter. The upper arms are for holding the instrument in position. It is used in the same way as the shears, and will be found very useful.

Metznik has invented a shears in which the strength of the hands, acting through a series of levers, is found sufficient to cut teeth without having recourse to a screw (Fig. 284). It is of service, but would be better if the limbs were narrower and more easily movable. Even when using

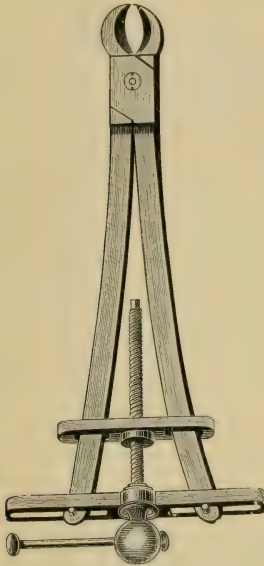


FIG. 281.—Tooth shears.



FIG. 282.—Tooth shears.

interchangeable jaws, it is occasionally found too narrow for broad teeth and too broad for narrow ones.

PREMATURE WEAR OF THE TEETH.

Defective resisting power in the teeth and the consumption of hard food sometimes produce premature wear, so that the animal becomes unable properly to grind its food. This condition is met with in herbivora as well as in carnivora. Dralle found all the molars in a twelve-year old horse so much worn and so loose, that they could be partially withdrawn from their sockets with the fingers. Pallin wrongly described this condition in a thirty-year old horse as perio-

dontitis. Only exceptionally in middle-aged horses are the molars worn down to the root and mastication impeded. Cases occurring in early life are usually serious. They clearly result from individual

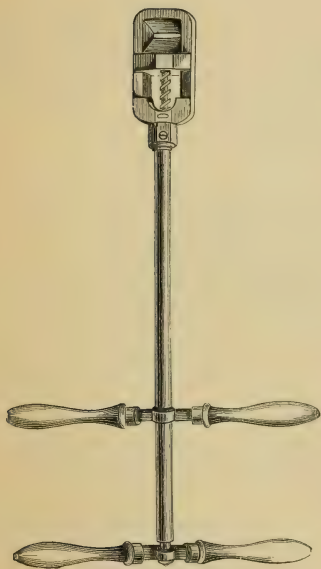


FIG. 283.—Tooth screw.

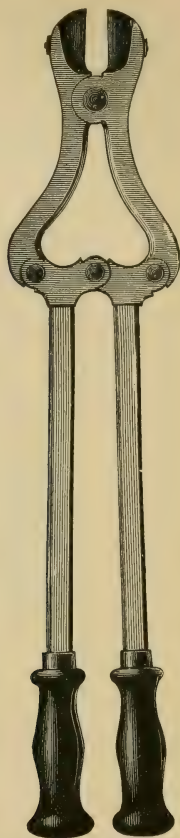


FIG. 284.—Metzniek's improved Tooth shears with interchangeable jaws.

idiosyncrasy, consisting in defective hardness of the enamel and dentine. The only useful treatment consists in giving soft and crushed food to assist mastication and prolong the workable period.

THE SMOOTH MOUTH.

Enamel and dentine being of unequal hardness, the latter wears away more rapidly and produces the roughened fold-like appearance on the grinding surface of the molar, requisite for effectively tritulating the food. But when enamel and dentine wear at the same rate the surface becomes even and polished. In advanced age this normally occurs, because in the deeper portions of the tooth the enamel ceases. It also occasionally occurs in young animals on account of insufficient hardness and durability of the enamel, and is more serious than in older horses. The smooth mouth during mastication resembles an uncut millstone during grinding. Mastication is of course less impeded when single teeth are affected than when the condition is general.

Treatment is confined to palliatives, giving crushed or ground grain, gruel, or bran mash, and allowing longer time for feeding.

The opposite condition in horses is termed "**ruminant's mouth.**" The grinding faces become exceedingly uneven. This is normal, however, so long as the molars have not come into wear; but it rarely persists, and is seldom troublesome.

(C) DISEASES OF THE TOOTH PROPER.

DENTAL CARIES (CARIES DENTIIUM).

The term "Caries" is used to describe the process which results in the decay or destruction of the cement, dentine and enamel of the teeth, the enamel, by its structure and resistance, being more slowly destroyed than the other constituents of the tooth. At one time Möller was doubtful whether caries occurred in animals, but Kitt's observations and his own later experience show that this opinion was not strictly correct, and he has lately reported some cases of undoubted caries in the molars of horses. Kitt has pointed out that in animals it takes the form of dry chronic caries, and Baume has noted the same fact in connection with ruminants and dogs. He states that the process starts either in the cement of the enamel folds, or in the centre of an "island" of dentine. Stockfleth and Kitt believe that caries starts in the remains of the osteo-cement pulp, that is, in the tissue which in the embryo forms the cement. This material, or at least the space left by its contraction, is seen when a tooth is cut through with the shears. It begins just below the grinding surface, and reaches downwards as far as the involution of the enamel. Sometimes it is even visible on the grinding surface,

and food then penetrates, filling the cavity with a black powder. This decomposes, micro-organisms develop in it, and the surrounding cement and dentine become carious; a hole thus gradually forms in the tooth, and increases in size (Fig. 285). The process, therefore, usually starts at the wearing surface, and, having destroyed the crown, extends to the base of the enamel cavity, and even to the pulp. The pulp cavity may then be crammed with particles of food, and suppurative alveolar periostitis result, with its attendant symptoms. The tooth itself assumes a darker colour, and becomes loose. It may then split lengthways during mastication (spontaneous fracture), or pieces may break off.

Symptoms. The disease is seldom recognised at first, the only sign being a scarcely appreciable darkening, generally on the wearing

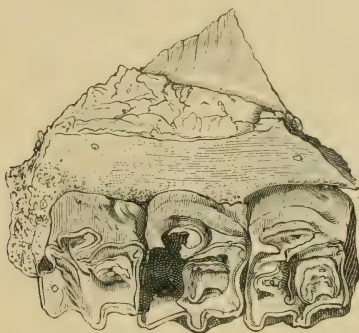


FIG. 285.—Central dry caries of a horse's upper molar (Kitt).

surface. At this point a cavity forms which gradually increases in size (Fig. 285), its walls, formed of the remains of the dentine, being of a black-brown colour. This stage is rarely noticed, and the disease only receives attention when "quidding" occurs, or when alveolar periostitis has set in. On attempting to extract the tooth it is found to be very fragile.

The process may continue for long periods, and finally lead to more or less complete destruction of the affected tooth, though the production of alveolar periostitis or splintering usually necessitates extraction. When removed, a cavity is found in the dentine. Stockfleth says the disease occurs even at six or seven years of age, though it is commonest at nine or ten; but in older horses it is less frequent.

Causes. In man caries, which consists in decalcification of the

enamel by lactic acid, is produced by fermentation of the fluids of the mouth, or of carbohydrates remaining between the teeth. This process is caused by micro-organisms, and may involve several teeth at the same time. In animals caries probably depends on similar causes, but it is exceedingly rare. It is not known whether this rarity is due to the more rapid wear of the teeth in animals, or to some peculiar property of the saliva. Stockfleth considers that a predisposition to caries is often inherited.

Prognosis depends entirely on the extent of the caries. In man its extension can be checked by "stopping" the tooth. With this object the cavity is drilled, cleared of all carious matter, thoroughly disinfected, and filled with some material which will protect the still healthy parts from further attack. The "filling" consists either of metal, like gold or amalgam, or of some other hard substance, such as cement. Very rarely, however, can this be done in animals, least of all in horses. It is, therefore, seldom possible to save a tooth when once attacked, the more so as the condition is usually only noted when disease is extensive. It then becomes a question whether the animal is able to masticate sufficiently with the teeth that will remain after those which are diseased have been extracted. In the horse, caries seldom affects a number of teeth, hence this question is usually determined in the affirmative. Varnell states having used a stopping of gutta-percha, Wulff a resin composition, and others an amalgam. The details of these cases are, however, so meagre that it is impossible to say whether the condition was really one of caries. No doubt caries can be arrested by thoroughly cleansing and properly filling the carious cavity. Stoppings are sometimes used to replace lost teeth.

Treatment consists in early extraction. Care, however, is required in using the forceps, as the softened crown is liable to break off. The "Universal" forceps (Fig. 294) must not be screwed up too tightly, and if the tooth be loose particular care is necessary. Extraction is easiest where purulent alveolar periostitis exists, or where the tooth is splintered. In such case Günther's pointed forceps are sometimes sufficient. Where the crown is broken off but the fang remains firm it can only be removed by punching.

FISSURES AND CAVITIES IN THE TEETH.

Fissuring is commonest in the horse's molars. It is rarer in oxen, not because these animals less frequently pick up stones, nails or similar hard bodies—the contrary is the case—but because they

swallow them directly, without much mastication, and because such objects are then retained in one or another of the stomachs. The fourth molar, which stands in the centre of the curved row, and suffers most under the severe friction of one grinding surface on the other, is most frequently affected. Without doubt want of hardness, which is often produced by caries, greatly favours splitting, while other causes may lower the resistance of the tooth. Such conditions may possibly originate during foetal life, a view which receives confirmation from corresponding teeth on either side being often splintered. Hard substances accidentally present in the food also produce splitting, especially in animals which masticate energetically. Sometimes only a piece of the crown breaks off, but very frequently the crack extends as far as the root. The tooth may be broken into several pieces, which separate, injure the tongue or cheek, and make chewing painful. While fissuring is confined to the crown no serious consequences ensue; but should the fracture extend to the alveolus, particles of food and fluids may enter and inflame the alveolar periosteum.

Treatment consists in removing the splintered tooth, and is seldom difficult. Sometimes the pieces are too small to be grasped by ordinary forceps, and in such cases Günther's pointed forceps are useful (Fig. 291).

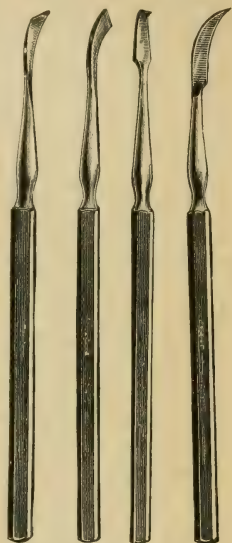


FIG. 286.—Teeth scalers for dogs.

DENTAL TARTAR (CREMOR DENTII).

Alike in animals and man the fluids of the mouth deposit on the teeth a grey-brown coating called tartar. It is commonest in dogs and vegetable feeders, but very rare in cats. Pet dogs suffer oftener than others. According to Fürstenberg's investigations tartar in dogs and horses consists principally of phosphate of calcium, carbonate of calcium, carbonate of magnesium, and organic substances. Iron and manganese have also been detected. Microscopical examination shows that the material is formed chiefly of vegetable particles, various bacteria, epithelium from the cavity of the mouth, and salts of calcium held together by salivary mucus. The deposit is

oftenest seen on the outer surface of the crown, turned towards the cheek. It commences in the neighbourhood of the gums, and gradually spreads upwards and downwards. Incisors and molars are alike affected, the latter more frequently, but in horses the tushes are the commonest seat.

A pale yellow or greyish-brown chalk-like substance, rather rough on the surface, covers that portion of the crown lying nearest the gum. In the dog it stands out clearly on the shining white surface of the tooth. Hertwig states that in goats tartar sometimes appears black and metallic from admixture of oxide of iron.

The deposit spreading may completely encapsule the crown above ; while, as it increases below, it produces atrophy and recession of the gum. Here lies the chief danger. As soon as the alveolus is exposed it becomes inflamed by the fluids of the mouth. This is by far the commonest cause of alveolar periostitis in dogs, and is especially frequent in house dogs.

The food decomposes in the alveolus, producing a grey slimy material which can be partly squeezed out by pressure, and has a peculiarly penetrating odour. The gum is bluish-red and swollen, bleeds easily, and is sometimes studded with little abscesses. The disease has hence been named "scurvy," whilst, on account of the offensive smell, it is also known as "mouth rot."

The black coloration, produced by feeding on husks and brewers' grains, must not be confounded with tartar. Its exact nature is not known, but it affects only the surface of the crown. The significance of tartar lies in the possibility of its exciting alveolar disease. Provided the alveolus is healthy, recovery follows removal of the deposit ; but teeth already much loosened can only be extracted. The smell is often so offensive that the dog cannot be tolerated in the house.

Treatment. The deposit is removed with teeth scalers or similar instruments (Fig. 286), avoiding injury of the gum or alveolus. To get rid of the incrustation, the teeth may be regularly cleansed for some time with pumice or citric acid. Sporting dogs being the usual patients, these measures can be carried out thoroughly. The gum is protected by placing the instrument close to it, and scraping towards the table of the tooth. Immediately the tooth becomes loose, extraction is the only resource. The fætor of the mouth can be removed by brushing the teeth with a solution of potassium permanganate.

(D) DISEASES OF THE ALVEOLI.

ALVEOLAR PERIOSTITIS.

Alveolar periostitis (*Periostitis alveolaris*) is by far the commonest dental disease of herbivora and carnivora, and especially of dogs. As its development, symptoms, and causes vary considerably in different classes of animals, it will be considered separately in each class.

Alveolar Periostitis in Herbivora. The roots of the teeth are fixed in the alveoli by the alveolar periosteum or alveolar dental membrane. The outer layer of the periosteum lines the alveolus, the inner layer the root of the tooth. At the point where the periosteum becomes continuous with the outer surface of the jaw-bone the gum is attached, and it serves to prevent foreign bodies or food entering the alveolus.

Depending on their character, two forms of alveolar periostitis may be distinguished. (1) Chronic ossifying, and (2) purulent alveolar periostitis. Those forms of alveolar disease resulting from local invasions of actinomyces or from tumour formation are described elsewhere. The chronic ossifying form is characterised by the formation of exostoses at the root of the tooth, which appears either roughened, or covered with flat, or knob-like masses of new bone; the latter greatly hindering the extraction of the tooth. In the purulent form the periosteum is usually thickened and extremely vascular; at points it is covered with granulations, and separated from the wall of the alveolus or root of the tooth by a quantity of grey-coloured offensive bone pus. Opposite these points the bone or root of the tooth is often eroded to the extent of one-sixteenth of an inch or more. In occasional cases, one sees extensive bone necrosis followed by suppurative osteomyelitis of the lower jaw. The periosteum usually becomes diseased in spots or on one side of the tooth, but in very old-standing cases disease may be so extensive that the tooth lies loosely in the alveolus and can be removed with the fingers. Frick has seen some cases where only a few plate-like fragments, the remains of the enamel, filled the alveolus. In all old-standing cases the smell is very offensive.

The above two conditions are often associated, so that at one point the tooth shows discrete exostoses and at another limited areas of purulent alveolar periostitis.

Causes. Alveolar periostitis almost always results from injury to the gum, or its separation from the tooth. Fissures of the tooth reaching to the root, and laying open the root-canal, occasionally produce it. Portions of hard food, especially hard chaff, may easily

become insinuated between the tooth and the gum and remain fast, movements of the tongue and cheeks not sufficing to remove them. Purulent periostitis, with separation of the periosteum from the tooth, supervenes. Masses of food penetrate into this enlarged space, widening the division between the alveolar wall and the tooth, and increasing inflammatory action. Separated from the periosteum, the tooth loses its firm seat in the alveolus, and, yielding to the resistance of its neighbour, is diverted from the common line, and may be so displaced that it can be removed with the fingers. Its root appears completely denuded of periosteum and bathed in pus. Similar results are produced by the entrance of food between the teeth, as happens in old age when the crowns are not in close contact.

In dogs and horses, alveolar periostitis may result from epulis, the tumour, either a sarcoma or carcinoma, having loosened the tooth and allowed food to enter.

The disease develops more rapidly when the tooth has been fissured, allowing food or fluid to enter the alveolus, and when compound fractures of the jaw extend to the alveolus. Less frequently the malady arises from the root canal. During wear of the tooth the canal is progressively closed with cement substance. But should wear outstrip this protective process, the root canal and pulp are laid bare on the grinding surface; food or decomposing buccal secretions enter, and occasion purulent inflammation of the pulp (pulpitis purulenta). This may extend downwards to the base of the alveolus, reach the alveolar periosteum, and finally produce purulent periostitis. In a lower molar of a five-year-old horse Frick found the pulp cavity occupied throughout its length of 4 inches by a fragment of straw, which had set up alveolar periostitis, and eventually dental fistula.

Kitt states that in the molars of old horses the central invaginated portion of enamel often becomes worn away, and the pulp chamber exposed. Food then enters and produces pulpitis, which extends to the alveolar periosteum.

Complicated fractures, or even external injuries, of the jaw may occasionally cause alveolar periostitis. This is commonest in young horses, in which the alveoli of both the upper and lower molars are at points only covered by periosteum and skin. In such cases injuries may directly affect the root itself or the alveolar periosteum, but the inflammation usually remains localised. A predisposition to alveolar periostitis is observed in various forms of faulty teeth, especially in shear mouth, and where the teeth are far separated. In consequence of their slighter make and less strength, the lower molars are oftener

diseased than the upper. The third and fourth molars are most commonly affected, which Günther ascribes to their central position in the fan-shaped arrangement (Fig. 295), and to their consequent exposure to powerful compression, both from in front and from behind.

Alveolar periostitis of the incisors is very rare in horses and ruminants, is generally of a secondary nature, and is due to injury of the interdental space or compound fracture of the alveolar process.

Though single teeth are often affected, it is common for several to become diseased together, frequently corresponding teeth, like the right and left third lower molars. The cause of this symmetrical occurrence is not quite clear, though it may be due to abnormal development. Where several neighbouring alveoli are diseased, and

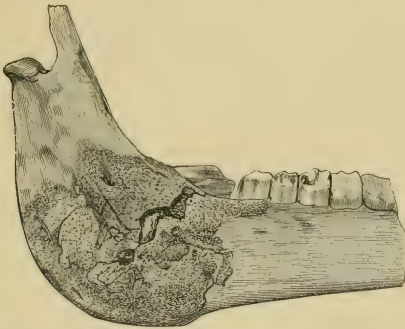


FIG. 287.—Necrosis of a dental alveolus, with displacement of the last molar and extensive ostitis of the lower jaw (horse).

especially where the teeth are very loose, a suspicion of some new growth is always justified.

Many cases remain confined to the alveolus. When an upper molar is completely loosened it may fall out; lower molars are not so readily displaced, though they may be equally loose; for this reason, the loose molars which can be extracted with the hand are usually found in the lower jaw. Sometimes inflammation starts in the thin plate of bone which forms the alveolus and extends to the medulla. Purulent osteomyelitis thus results. This irritates the periosteum, producing periostitis ossificans, which enlarges the bone. Finally, towards the inferior border of the jaw the pyogenic process breaks through the bone, and a dental fistula results. After discharge of the pus, granulations form, and the point of perforation heals up, until only a narrow channel remains communicating with the alveolus

or root of the tooth. This persists (compare "dental fistula"). In disease of the upper alveoli pyogenic infection sometimes extends into the superior maxillary sinus. Perforation into the nasal cavity may follow disease of the pre-molar alveoli and produce a chronic nasal discharge. Occasionally the alveolar wall becomes necrotic and extensive ostitis ensues. Fig. 287 shows how much a tooth may be displaced. The last molar lay horizontally, and under it a piece of bone the size of a hen's egg had become necrotic.

The symptoms consist in slow, interrupted, one-sided mastication, rolling of the tongue, slobbering, and dropping food from the mouth. Even from the outside it may be discovered that one or another of the teeth is displaced; while the cheeks are distended with masses of food. On passing the hand into the mouth, the exact displacement is ascertained. The peculiar, repulsive so-called "carios" smell, especially noticeable in the retained masses of food, is quite characteristic of alveolar periostitis. In dogs the smell, whilst very offensive, is somewhat different from that in horses. Closer examination shows that the gum has receded from the affected tooth, which is so loose as sometimes to be movable by the fingers. It is usually pushed out of line or lies deeper than the others. As might be expected from the direction of their wearing surfaces, the upper molars are generally displaced outwards, the lower inwards.

In cattle, epileptiform seizures sometimes occur. In chronic cases the animal wastes. In the lower jaw the bone enlarges and fistula forms, indicating the position of the diseased tooth. If the interior of the mouth be illuminated by a mirror, changes in the teeth as well as in the gums may usually be very plainly seen.

Treatment. Extraction is the only certain method of dealing with alveolar periostitis. This is comparatively easy in old subjects, whether horses or oxen, but may be more difficult in younger animals, especially when the crown of the tooth is broken, as not seldom happens. Several teeth may be simultaneously affected, or one soon after another, and under such conditions the prognosis is less favourable. It may then be a question whether the animal, with its still remaining teeth, can chew sufficient food, and vegetable feeders frequently cannot do so. Punching out the diseased tooth, as adopted in former times, is now only resorted to when the forceps cannot be used owing to the loss of the crown. The operator commences by trephining the jawbone as nearly opposite the root of the affected tooth as possible. The success of the operation depends on the choice of the proper spot. In the upper jaw the landmark is the lower end of the zygomatic ridge of the superior

maxillary bone, which lies at the division between the third and fourth molars. Alterations in the diseased tooth or its gum may usually be detected by introducing the hand into the mouth. Should the tooth be displaced and loose, there need be no doubt as to its condition. A round punch about one half to three quarters of an inch thick and with a flattened end or, in certain cases, a bent punch like an angular doorbolt, is now placed on the root of the diseased tooth, care being taken that the punch points in the general direction of the tooth itself. Light blows on the punch with a rather heavy hammer drive the tooth from its socket into the mouth. During operation a hand should be passed into the mouth and applied to the diseased tooth to ascertain the effect of the blows. The pain of repulsion makes the use of an anæsthetic necessary, and even in deep narcosis some animals react to the blows of the hammer.

Only the pre-molars and the first two molars of the upper jaw can be removed by punching. The last molar having its root in the hindmost portion of the superior maxillary sinus cannot be conveniently reached, nor can the back molars of the lower jaw, lying as they do too far from the lower border of the bone. Care should be taken in using the punch to strike only the affected tooth, otherwise neighbouring teeth may be loosened, or the maxillary bone fractured.

During punching a mouth gag must be used to allow of the hand being introduced to catch the tooth and prevent its being swallowed. A preferable method consists in only driving the tooth so far downwards as to enable it to be reached from the mouth with forceps, with which extraction is completed. Bouley and Stockfleth, by performing an œsophageal operation, succeeded in removing teeth which had been swallowed; but in another case the tooth produced perforation of the cæcum and death. In operating on the upper jaw it is necessary to avoid injuring the fifth and seventh nerves; in the lower jaw the inferior maxillary division of the fifth. After removing the tooth the socket is plugged with a piece of antiseptic tow, or gauze, which, if possible, should be renewed daily. In some cases this is indispensable to enable the animal to drink. The opening usually closes in three to six weeks, but sometimes not till later; occasionally a fistula remains. The trephine opening should not be allowed to close until the alveolus has been filled up. Bad results seldom follow skilful removal, but where the tooth or jaw bone are splintered serious bleeding or pus formation may ensue.

Extraction with forceps, when possible, is preferable to the above described method. It is simpler and less painful, although requiring

some practice, strength, and judgment. Drawing a tooth is much less difficult in old than in young animals, in which the molars are still deeply implanted in the jaw.

In such cases attention should be paid to the following points:—

Choice of Forceps.—Those designed by Günther, Robertson, and Gowing are amongst the best. They must be very strong, so as not to spring much, but not very thick in the jaws, as this makes adjustment difficult. As the horse's molars do not lie parallel to one another, attention must be

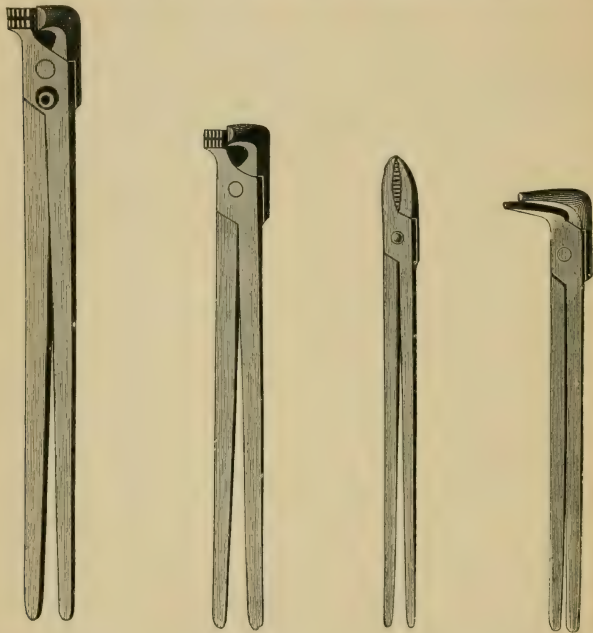


FIG. 288.—Günther's forceps for upper molars.

FIG. 289.—Günther's forceps for lower molars.

FIG. 290.—Günther's exporteur.

FIG. 291.—Günther's beaked forceps.

given to the direction of the pull, and Günther therefore constructed special forceps for each tooth.

Forceps acting as levers of the first class, and those as levers of the second class, must be distinguished. In the former the jaws are at the end (Figs. 288 and 289), in the latter at some distance from it (Figs. 292 and 293). As the molars are arranged in a fan shape, the crowns of the pre-molars look backwards, those of the molars forwards (Fig. 295); and as it is of the greatest importance that the pull should come in the direction of the long axis of the tooth, it is clear that the second class lever forceps

are suitable for the pre-molars, the first class lever for the molars. For the upper pre-molars the forceps must be somewhat bent just in front of the jaws, so that in pulling, their legs may not strike against the incisors of the lower jaw (Fig. 293). Forceps for the upper molars require wider jaws or removable joints. The limbs of molar forceps must be very long. In using them force has to be exerted in two ways—firstly, to grasp the tooth, and secondly, to remove it. Attempts have therefore been frequently made to assist the operator by special arrangements in the forceps. The



FIG. 292.—Günther's forceps for first lower molars.



FIG. 293.—Günther's forceps for first upper molars.



FIG. 294.—Frick and Hauptner's "Universal" forceps.

simplest addition is an S-shaped hook, but as this must be provided of many different sizes, it is not very practical. Frick and Hauptner have constructed forceps in which the power required for gripping the tooth is furnished by a screw. This instrument has the further advantage that it can be used either as a first or second class lever forceps. Fig. 294 shows its construction. The two limbs are turned on their long axis by the screw at the end, and the mouth of the forceps thus closed.

The use of the forceps shown in Figs. 288 and 289 necessitates fulcra or pivots of different thicknesses. As will be seen from Fig. 295, which shows

the teeth of a six-year-old horse, the roots of the pre-molars point more or less forwards, whilst those of the molars take an opposite direction.

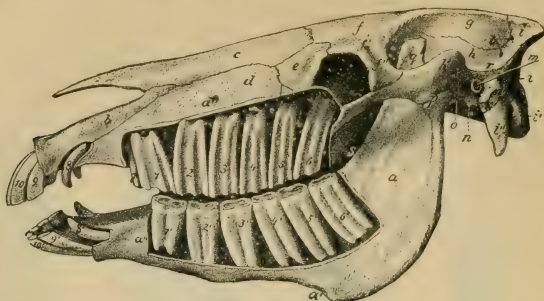


FIG. 295.—Showing the incisor and molar teeth of a six-year-old horse in position.
(After Ellenberger and Baum.)

The pre-molars accordingly must be grasped deep down and a thick fulcrum selected. In drawing molars the practice is reversed, the tooth is gripped

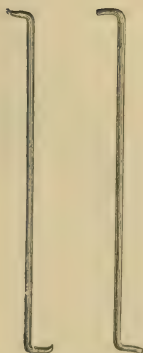


FIG. 296.—Tooth pickers (Günther).

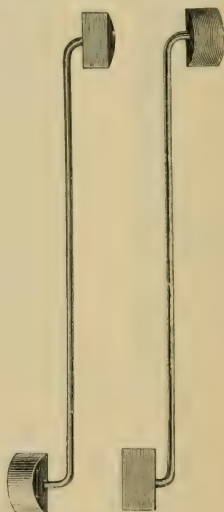


FIG. 297.—Fulcra.

just below its upper surface; the pivot should be thin, or better still, a second-class lever forceps may be used.

Though it is possible to extract molar teeth from old and quiet horses

in the standing position, it is generally advisable to cast the animals. A halter is put on and a mouth-gag inserted. An assistant sitting on the horse's neck directs its head towards the light, whilst another passes a cord across the upper interdental space, and draws the head upwards and backwards.

The operator having satisfied himself as to the condition of the mouth, and provided the proper forceps and fulcrum, proceeds with extraction :—

(a) *Adjustment of the forceps.*—In carrying this out, the above facts must be remembered. Difficulties often arise at once; sometimes room is wanting between tooth and cheek, either because the jaws of the instrument are too thick, or because food has accumulated, or, finally, because the crown of the tooth has been pushed against the cheek. In the first case another forceps may be tried, in the second the food is removed with a toothpick (Fig. 296); in the last the tooth should be pushed back, if possible, or if this is impracticable, the opening of the gag must be diminished, and the jaw pushed sideways in the direction of the displaced tooth.

Sometimes room is wanting between the upper and lower rows of teeth. Should the size of the forceps be to blame, they should be changed; where the opposite tooth is too long, it must be shortened or removed. In placing the forceps in position, care is required not to grasp more than the diseased tooth. In extracting pre-molars, a hand may be introduced into the mouth to guide the instrument. The displacement of the tooth often simplifies the determination of its position and the adjustment of the forceps. In using the Frick-Hauptner forceps (Fig. 294), the correct position is assured by counting the teeth in front of the jaws of the instrument.

(b) *Teeth that are still firm can be loosened by light lateral movements of the instrument.* But to avoid breaking the crown of the tooth or fracturing the jaw, it is needful to proceed slowly and cautiously.

(c) *Selection and adjustment of the fulcrum.*—When using first-class lever forceps, as already stated, the selection of the fulcrum must be made with a knowledge of the general direction of the axis of the tooth, to which the fulcrum should be brought as near as possible, in order to give greater leverage.

(d) *Extraction of the tooth.*—The operator takes up a firm position, with his elbows on his sides, and giving the word to hold fast, exercises a steady but strong pull on the forceps, throwing on them the weight of the body. The power required to draw a tooth in the prone subject is developed by the muscles of the thighs, the power of the arms not being usually sufficient. The arms, or rather the hands, are employed in grasping the limbs of the forceps, so as to retain hold of the tooth.

Should the attempt be successful, the tooth is felt to yield, and a hissing noise may sometimes be heard, due to the air rushing into the alveolus. In such case the tooth is still firmly held, but the pull is relaxed for an instant. A deeper fulcrum is slipped under the forceps, and a light pull will now generally remove the tooth. As in young animals the teeth are longer, a fresh and deeper hold is often needful. Short teeth can be removed directly with the forceps, but longer ones may require the assistance of the hand or exporteur (Fig. 290). The opposite teeth sometimes prevent removal of the loosened molar. In such cases more room must be made, either by opening the gag further, or by closing it and

pushing the lower jaw to one side, in order that the two rows of teeth no longer oppose each other. The tongue, however, should not be loosened, for fear of the tooth falling into the mouth and being swallowed.

If, during extraction, the animal makes violent movements with the head, the operation is stopped, but the movements are followed by the forceps. This is especially necessary when operating on horses standing. If the forceps are held rigidly, the jaw may easily be fractured by the animal's own movements.

If the forceps are not firmly held they may slip off the tooth and require to be readjusted. Should this happen repeatedly, and, even after considerable efforts, no loosening of the tooth occur, endeavour must be made

to discover the cause of failure, which most frequently results from an improper hold having been taken, the pull being in a wrong direction, or two teeth being grasped. A change of forceps or of pivot is often desirable. It may be repeated, that the direction of pull should correspond with the long axis of the tooth, otherwise power is lost by the tooth grasped being forced against its neighbour. In certain cases (dental fistula, growths, either in the alveolus or on the tooth), extraction may be very difficult, or even impossible.

For extracting molars, a tooth-key, resembling that formerly used in human dentistry, has been recommended. But, unless for removing the short teeth of old horses, this instrument is useless.

The extracted tooth generally shows evidence of pathological changes. Where purulent periostitis has existed, the root is roughened and denuded of periosteum, and exhibit shreds of periosteum, and

sometimes exostoses.

Treatment after extraction is seldom necessary, but when cleansing the parts a plug of tow or jute soaked in a disinfectant may be introduced into the tooth socket. It is particularly useful where dental fistula has existed, but must be renewed daily.

In drawing several teeth at one time, it is well first to extract the lowest and most posterior. This minimises the difficulties caused by bleeding. Cases of unusually large teeth have been reported. Degive extracted a horse's tooth which weighed 15 ounces. Teeth are said to have been successfully transplanted, but such reports must be received with caution.

In 1887, in the clinique of the Berlin college, the first upper molar of a carthorse was removed by punching, as the tooth crown was broken away. Three years later the horse was brought back, the owner stating



FIG. 298.—Günther's forceps for the incisors.



FIG. 299.—Ordinary forceps for the incisors.

that it had for a long time suffered from an offensive nasal discharge. An examination showed that the left nostril was blocked with masses of food, which had entered by an opening in the now empty alveolus. The passage was large enough to admit the little finger. The upper maxillary sinus proved healthy on trephining. After carefully removing every particle of food from the nostril, and cutting down the overgrown first molar of the lower jaw, the alveolus was thoroughly cleansed and stopped with a mass of gutta-percha, softened in hot water. To give it a more secure hold, a few grooves had previously been filed on the adjoining tooth. The nasal discharge ceased after this operation, and several weeks later the gutta-percha was found still in position, and quite fulfilling its object. Mastication appeared in no way disturbed, and the horse lived for several years in the same condition. Voigtländer describes a similar case, though the horse had finally to be killed. Some very interesting cases of this character will be found in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery."

It is seldom needful to extract incisors, though the operation is often done by horse-dealers to give horses the appearance of greater age. The operation is called for where milk teeth remain confined between the permanent incisors, or where the premaxillary or submaxillary bone is fractured and the alveoli exposed.

Günther's forceps are the best (Fig. 298). The projection just in front of the jaws of the instrument serves as a fulcrum, and should be rested on one of the neighbouring teeth. Incisors can also be pulled with human forceps made rather longer and stronger than usual (Fig. 299). The same instrument serves as an exporteur.

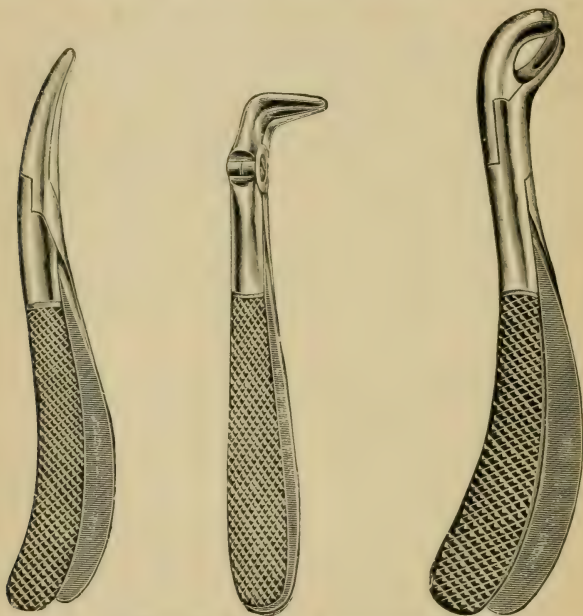
Alveolar Periostitis in Carnivora. Dogs, especially those kept in the house, are the most frequent sufferers. Compared with alveolar periostitis in herbivora, the disease in dogs differs both in its advent and progress. A large number of teeth are usually attacked, sometimes nearly all; both molars and incisors suffer, and old dogs may be reduced to an absolutely toothless condition.

Symptoms. The edges of the gums are swollen, more or less reddened, and bleed on the least touch. At points where the tongue cannot easily reach, as along the external borders, the gums are moist with a grey slimy fluid of a particularly penetrating odour. The crown of the tooth is partly covered with grey chalky masses of tartar, which intrude under the gum in the direction of the alveolus, loosening the tooth, and causing it to fall out. Where the disease is extensive, the animals salivate freely, eat badly, and either avoid gnawing bones, or whine occasionally during the process, whilst the mouth emits a most offensive smell. Sometimes single teeth become loosened and partly displaced, preventing the animal closing the mouth, and giving rise to suspicion of rabies.

The condition was formerly regarded as systemic, and received such names as scurvy, mouth-rot, &c. But neither fever nor other

constitutional symptom is present, and recovery takes place as soon as all diseased teeth are removed.

The formation of tartar, or the extension of caries, as already stated, is the immediate **cause** of alveolar periostitis. The tartar is deposited on the teeth, and continually advances towards the gums, producing inflammation and necrosis. The alveolus is finally exposed, putrefactive organisms enter from the mouth and maintain the irritation. The grey stinking material discharged when the tooth is



FIGS. 300, 301, 302.—Dental forceps for dogs.

pressed upon consists almost entirely of exudate and putrefactive bacteria. A predisposition to this formation of tartar exists in certain races of small dogs, and is possibly aggravated by inappropriate feeding.

Preventive treatment calls for the removal of tartar before alveolar disease has appeared. The incrustation can be scraped off in the manner already described. It is advised to paint the diseased spot with a weak solution (1 : 2000) of permanganate of potassium, which is further useful in removing smell. All loose teeth must be removed, otherwise success will never be attained.

In dogs, extraction presents no difficulty : an assistant holds the animal, and human forceps may be used. The tooth is seized with forceps of suitable size, and a rapid drawing movement made, usually towards the tongue. Operating on the right side, traction is made towards the left, and *vice versâ*. The crown is usually firm, but the root loose. The tooth key may be used if thought suitable. Artificial teeth have been used in dogs. Moseley reports having fitted a full set with such success that the dog could afterwards crush bones. A Schipperke wearing a gold plate was exhibited at the Central Veterinary Medical Society. But these achievements are in the nature of scientific amusements.

DENTAL FISTULA.

This may be defined as a tube-like canal communicating at one end with the external air and at the other with a tooth root or socket. It almost always results from alveolar periostitis, the inflammatory process extending and producing an osteomyelitis purulenta, which finally leads to perforation externally. Inflammation then abates, until the alveolus alone remains inflamed. The small quantities of pus produced find exit through the communicating channel.

Dental fistula occurs oftenest in young horses. It affects the first and second pre-molars, seldom the third, and is commoner in the lower than in the upper jaw. Fistula is very rare in the molars, because their roots are protected by thick masses of muscle, and in the upper jaw project into the superior maxillary sinus. Despite these facts, such fistulæ do occur. They open into the superior maxillary sinus or into the nostril, producing empyema of the sinus with chronic nasal discharge, which has the peculiarly offensive smell of alveolar periostitis.

In dogs, dental fistulæ originate most frequently from the upper molars. The outer opening is usually near the lower eyelid, and might be mistaken for that of a lachrymal fistula, were it not that probing shows it to communicate with a molar tooth. For a descrip-



FIG. 303.—Periostitis alveolaris ossificans of the third molar (horse).

tion of several cases of dental fistula in the horse, dog and cat, see Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery."

Causes. *Fistulæ*, though generally preceded by alveolar periostitis, may be produced by complicated fractures or injuries of the maxilla. Hertwig believed pre-molar fistulæ in the lower jaw to be commonly caused by wounds inflicted by narrow and inclined mangers. We can support this view, having seen many cases of pre-molar fistula in young animals exhibiting no disease of the alveolus, but traceable to external injury of the lower jaw. The root of the tooth is often thickened, surrounded by actively-growing granulation tissue, which becomes covered with fresh cement; a periostitis alveolaris ossificans results, with formation of hyperostosis radialis (Fig. 303), and extraction is rendered difficult, or even impossible.

The symptoms consist in the appearance of a little funnel-shaped depression in the skin of the lower margin of the under jaw, or of the upper jaw at the height of the roots of the pre-molars. Sometimes the fistula opens within the mouth near the affected tooth, as may be proved by injecting the channel with a coloured fluid. A fine sound being introduced, meets with a hard substance—tooth, or bone, or it may pass into the mouth. Round the external opening and over the course of the canal the bone is rarefied and swollen. Mastication is not always impeded. Examination usually betrays signs of alveolar periostitis in the affected tooth.

Prognosis. Removal of the affected tooth is indicated. Hertwig describes a cure after application of the actual cautery and mopping with tincture of aloes, but such recoveries are exceptional. When the lower pre-molars have become diseased from external injury, recovery sometimes takes place without removal of the tooth. But usually infection of the alveolus continues, and pus formation prevents healing. Moreover, in such cases there is generally a difficulty in extracting the tooth. In dental fistula affecting the upper jaw a radical cure is impossible without removal of the tooth. In prognosis account must be taken not only of the disturbances caused by the diseased tooth, but also of the danger of extraction. Where inconvenience is slight, it may appear advisable to refrain from treatment. If, however, the fistula opens into the upper maxillary sinus or nostril, the tooth must be removed and the sinus trephined. Where perforation into the nostril is attended with necrosis of the turbinated bones, as not infrequently happens, the prognosis is unfavourable. The nasal discharge continues after extraction of the tooth, and betrays the peculiar smell of bone pus. After a time pieces of the

turbinated bones become loose, and pass out with the nasal discharge.

Where, however, perforation of the nostril and necrosis have not taken place, recovery usually occurs soon after removal of the tooth. But it is unwise to prophesy the termination—time alone can determine. To detect perforation into the nostril, Günther's catheter for the guttural pouch may be employed. On introducing it into the lower meatus, the point where the fistula opens will be felt as a raised and uneven patch.

Treatment may be attempted without sacrifice of the tooth if the fistula has resulted from an external injury, and produces no serious inconvenience, and if the tooth in question gives no evidence of disease. Proceeding on general surgical principles, the canal is washed out, its walls scraped with the curette, and dressed with chloride of zinc (1—10), or iodoform dissolved in ether. Solution of lactic acid has been recommended. If the alveolus is diseased the tooth is removed, and little further attention is required. Healing is hastened by inserting a plug of tow, saturated with a disinfectant. This may be renewed daily. In dogs the molar should always be removed, even though the crown appear sound.

NEOPLASMS OF THE GUMS AND ALVEOLI (EPULIS).

Under the common title of epulis are grouped all tumours originating in the gum or alveolus. In former times growths due, in the horse to botryomyces, and in the ox to actinomyces, were included under the general designation "Epulis." Dammann saw in horses cancerous tumours of considerable size, which sprang from the incisor necks. Roloff has described sarcomatous epulis in horses and cattle, and we have repeatedly seen such cases both in horses and dogs. The case illustrated (Figs. 304 and 305) was a myxosarcoma of very rapid growth, affecting a mastiff bitch. Beginning on the left side of the upper jaw, it extended from the first canine tooth for a distance of three inches backwards, involving all the pre-molars and molars, across the mouth to the left side, causing loosening of all the molars of that side; in an upward direction it affected the whole of the superior maxilla on both sides. The lower jaw, especially on the left side, was also involved. Sections revealed cystic spaces filled with blood-stained fluid; the interior of the superior maxilla resembled a piece of hepatised lung and the bones cut like those affected with osteoporosis. (Mettam, *The Veterinarian*, 1901.)

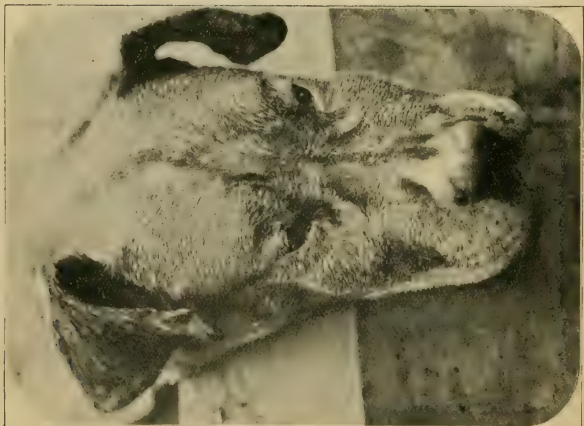


FIG. 304.—Epulis in a mastiff; showing deformity of face and upper jaw.



FIG. 305.—The same; interior of the mouth. The growth had involved both sides of the upper jaw and the intervening portions of the palate.

Diagnosis is not difficult. The new growth may attain such dimensions as to hinder mastication ; then the teeth at the affected spot become loose and fall out, while symptoms of alveolar periostitis are present. When in herbivora several neighbouring teeth are loose, one should always look for epulis formation. Keiper observed after fracture of the lower jaw in a foal a rapidly growing neoplasm, which he regarded as sarcoma. In fourteen days it attained the size of a child's head, and, owing to its position near the incisors, prevented feeding. As it recurred after removal, the foal was killed.

The prognosis is usually unfavourable. As soon as the new growth spreads beyond the alveolus its complete removal becomes very difficult. The tumour is apt to grow again from any portions remaining.

Treatment consists in complete extirpation, which, owing to the position of the tumour, is difficult. As the operation is very painful, an anæsthetic should be given. The growth may then be dissected out, the last traces being removed with the curette or actual cautery, Paquelin's form being the most useful.

DENTAL TUMOURS.

True dental tumours, odontomata, have very rarely been described in domesticated animals. Imminger saw an odontosarcoma following sarcoma of the jaw in a horse. Many of the "odontomata" recorded in current literature are only large exostoses developed on teeth in consequence of alveolar periostitis.

Dental cysts, found in the most varying positions in the animal body, are due to aberrant portions of the foetal paradental epithelium and are dealt with elsewhere. Williams, after trephining a horse's right superior maxillary sinus for an apparent tumour growth, found in its interior several hundred rudimentary teeth. The growth had extended into the mouth.

III.—DISEASES OF THE NOSE, NOSTRILS, AND THE SPACES COMMUNICATING WITH THEM.

(A) WOUNDS OF THE ALÆ OF THE NOSTRILS.

THESE occur most frequently in horses, which, when rapidly moving the head, may chance to catch the nostrils on such objects as hooks or nails. Sometimes they result from bites from other horses. Some savage tribes slit the false nostril, thinking to assist breathing. Injuries to the nose are less frequent in other animals. Though they

generally take the form of torn wounds, they heal steadily and quickly owing to the abundant connective tissue in their neighbourhood. But immediately the cartilaginous portions of the nose are injured, healing becomes difficult. Infection of the cartilage is apt to occur, causing chronic inflammation, thickening, or even fistula formation. In this way stenosis of the nostrils may be produced and the breathing affected.

Treatment of fresh wounds, especially of the nasal cartilage, should aim at healing by first intention. The parts must be cleansed, the edges of the wounds freshened and disinfected, and brought together with pin sutures, so as to lie firmly in apposition. The wound should then be painted with collodion or wound gelatine, and the horse put on the pillar reins to prevent its rubbing out the stitches. In working-horses small flaps of skin may simply be cut off. Healing is usually so perfect that neither the area of the nostril, and consequently the breathing, nor even the horse's appearance suffers. Necrosis of the nasal cartilage is serious and may continue for months. The fistula should be laid open and the parts frequently dressed with disinfectants, if necessary with chloride of zinc or nitrate of silver or even touched with the actual cautery. In chronic cases curetting, or excision of the necrosed cartilage is indicated.

(B) FRACTURE OF THE NASAL BONES.

In horses these fractures generally result from the animal running away, and the nose being brought in collision with some hard object. Falls, kicks, or powerful blows also produce them. Horses suffering from brain disease occasionally fracture the nasal bones by striking the head against a wall. In other animals the accident is rarer. In dogs it is sometimes due to a blow with a stick. The fracture may be single or double-sided, longitudinal or transverse, subcutaneous or compound. Fragments of bone may perforate either the skin or mucous membrane, and thus produce a compound fracture.

Diagnosis is not difficult. There is usually deformity of the nose and the neighbouring parts, bleeding from the nostrils, and sometimes difficulty in breathing, produced by narrowing of the nostril or accumulation of blood. Injuries to the lachrymal duct are indicated by obstruction, the appearance of blood-stained tears or of ecchymoses in the inner canthus of the eye. Tearing of the schneiderian membrane may be followed by profuse hæmorrhage and emphysema about the face. Diagnosis only becomes difficult where much swelling exists.

Prognosis is on the whole not unfavourable. In rare cases death results from bleeding or suffocation, or at a later stage from septic poisoning. So long as the fracture is subcutaneous and no great displacement exists, complete recovery may be looked for. In severe displacements, and especially where both bones are fractured, an *asthma nasale* may remain. Caries of the turbinated bones sometimes follows compound fractures.

Treatment of subcutaneous fractures without much dislocation requires nothing more than a few days' rest. Compound fractures must, as far as possible, be antiseptically treated, loose splinters of bone removed, and dislocated bones replaced. Where portions of bone have been driven inwards, replacement is most difficult. In large animals it may be effected by introducing into the nostril the nozzle of a clyster syringe, and therewith pressing the bone forcibly outwards, but this only succeeds in the lower part of the nostril. In the upper part the superior turbinated bone lies in contact with the nasal bone, and may easily be damaged by such manipulation, necrosis resulting. Care must also be taken not to convert a simple into a compound fracture. In some cases it is advisable to trephine and raise or remove pieces of bone which have been pushed into the nasal passage.

It must not be forgotten that dyspnœa may be produced by general swelling of the nasal mucous membrane, and that during the first forty-eight hours tracheotomy may become necessary. The owner should be warned of this contingency, especially when the practitioner lives at a distance. In certain cases it may be advisable at once to perform the operation.

(C) FOREIGN BODIES AND TUMOURS IN THE NOSTRILS.

Foreign bodies occasionally obtain entrance to the nostrils of horses and cattle, and remain for long periods *in situ*. With the exception of *Linguatula tænioides*, foreign bodies are rarely found in the nasal passages of the dog. Sponges or similar objects have even been inserted into the nostrils of horses in order to conceal a discharge, such as that of glanders. Hermann found a wisp of straw, Körner a piece of ribbon, in a horse's nostrils. In a horse Möller had under treatment the lower meatus was discovered to be full of food, which had entered through the alveolus of a molar tooth. Dusseau, in making the autopsy of a horse, found in the nostrils forty bean-like, hard white bodies, consisting of dried mucus and

epithelium, and believed them to have been formed in the guttural pouch.

New growths, in the form of polypi, often occur in the nostrils. According to Ercolani, Cato and Absyrtus were acquainted with nasal polypi; and in 1784, Icart is said to have removed one weighing 1 $\frac{3}{4}$ lbs. from a horse. The growths are most commonly fibromata and myxomata, though lipomata, osteomata, enchondromata, angiomata, sarcomata, and carcinomata have been found. They often originate from the protuberance of the ethmoid or the lateral wall of the nostril. Gurlt has seen them develop from the nasal septum, Rizot from the turbinated bones. Hamburger discovered an extensive myxofibroma in the septum nasi, whilst Lammers met with a case where the mucous membrane was thickened, and showing cavities containing numerous examples of *strongylus armatus*; Kitt observed a sarcoma in the nostril of a dog. Strerath found tuberculosis of the nasal mucous membrane in a calf. The animal had shown difficulty in breathing after taking food or water, and usually breathed through the mouth, making a snoring noise. The growths were of varying size, some as large as grains of corn, some like peas, others again were confluent and gave the membrane a fatty appearance. Strebel described a cyst containing a piece of bone, which he found in an ox. He considered it had originated in the ethmoid bone. New growths occasionally extend into the nostril from the brain cavity and maxillary sinuses. Cases of botryomycosis and actinomycosis of the nasal mucous membrane have also been observed in the horse and ox.

Symptoms. Both tumours and foreign bodies in the nostrils produce a muco-purulent discharge, which is generally one-sided, and often accompanied by bleeding. The pharyngeal glands are usually swollen. The air-stream from the affected nostril is weaker, and not infrequently a loud breathing sound, resembling that in roaring, is present, constituting asthma nasale. Compression of the lachrymal duct produces overflow of tears. When the condition becomes further developed, the nasal or superior maxillary bones or the hard palate appear swollen. Sometimes the growth even extends through the plate of bone. More exact information as to the nature of the case is obtained on examination with a speculum, with a sound, or merely with the finger. Polypi sometimes become so long as to protrude from the nostril. When they grow from the upper part of the meatus, the earliest symptoms are the before-mentioned asthma nasale and swelling of the nasal bones, but if their origin is low down, they may be felt and even seen soon after dyspnoea becomes constant.

When in the latter position they usually grow from the outer wall of the meatus, just over the base of the false nostril. This is a fact to be remembered both in diagnosis and treatment.

Dogs and cats with nasal growths sneeze and scratch, or rub the nose with the paw; sometimes they run along with the head in contact with the ground. In the former, *Linguatula tænioides* produces attacks suggesting rabies. Several cases of tumour formation in the nasal cavities in dogs are described at length in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery."

Treatment, to be successful, requires the removal of the foreign bodies or new growths. Necrosis of the turbinated bones and such complications as the growth of sarcoma are frequently irremediable. Foreign bodies can, as a rule, be seized and removed with a pair of dressing forceps. Sometimes it is sufficient to wash out the nasal cavity with a powerful jet of water. In men foreign bodies can be removed by blowing forcibly into the opposite nostril.

New growths, seated in the lower part of the nostril, may be extracted with the help of the so-called polypus forceps or Leverett's hooks (decapitating hooks). When somewhat above this, and especially if on the outer wall of the meatus, they may be removed thus:—An incision is made at the point of junction of the nasal and premaxillary bones, on the inner side of the false nostril parallel with the nasal bone, and the finger inserted to ascertain the size and position of the polypus. The growth may then be removed either with the fingers, a wire snare, or with the *écraseur*. But if the polypus is higher placed, the nasal roof must be trephined. Difficulty is often experienced in diagnosing the seat of the growth; this may sometimes be effected with a long sound, or with Günther's catheter for the guttural pouch. Trephining, if adopted, is better performed too high than too low. The growth, if possible, is removed by blunt dissection or ligation. Where the base of the polypus is broad, a curette is often of considerable service, but whatever the means employed, the principal object is completely to remove the growth. If bleeding prove alarming, the head may be placed in a pendent position, or the superior meatus or the posterior naris may be plugged with tow saturated with solution of adrenalin chloride, which may also be applied to the mucous membrane in order to check the flow of blood into the larynx. But the tampons must be secured by strong tape, that they may not fall into the pharynx and produce danger of suffocation. Under such circumstances it is advisable to perform tracheotomy and insert a tampon cannula. One of Möller's patients died from

cerebritis, owing to the inflammation extending from the point of operation to the brain.

The term "rhinoscleroma" was formerly given to a disease of the nose in man, usually following nasal catarrh, and producing general swelling both of the nasal mucous membrane and the external skin. The swelling, as the name indicates, is distinguished by its hardness, and may be of such dimensions that the nostrils are completely occluded. The schneiderian membrane appears livid. Anatomically, the thickening is like that of elephantiasis, and, according to later investigations, is caused by a specific infection—a micro-organism, similar to Friedländer's pneumococcus, having been found in the growth.

Whether this condition occurs in the lower animals has yet to be ascertained. The cases hitherto reported show peculiarities indicating other than micro-organismal causes. This view seems to be supported by a reported case of Jacobi's, where recovery followed the injection of Lugol's solution of iodine into the submucous tissue. A similar case was given in the *Zeitschrift für Veterinärkunde*. It cannot be denied that the nasal mucous membrane and the nostrils do become swollen as in elephantiasis, but whether such swellings should be looked upon as examples of rhinoscleroma cannot be determined without a fuller knowledge of their nature.



FIG. 306.—Facial œdema after injury.

In an omnibus horse the upper and lower lips and the nose became extremely thickened. Both nostrils and the lower lip felt hard. The swelling was smooth on the surface and the skin covering it was denuded of hair and closely adherent.

Some spots on the upper lip were deprived of pigment and appeared dull red in colour. The swelling was not sharply margined above, but gradually shaded off about 4 inches above the nostrils, extending somewhat higher, however, as it receded from the middle line of the face, and being continued in the form of a slender cordiform enlargement up to the masseter muscles.

The nostrils were $3\frac{3}{4}$ inches in length. The anterior edge of the lips extended about 3 inches beyond the incisor teeth. The mucous membrane of the lips and nose was little changed, and there was neither nasal discharge nor difficulty in breathing. The submaxillary and prepectoral lymphatic glands were swollen and hard. A small firm swelling was noted above the right eyelid and a hard, ill-defined but somewhat extensive swelling below the chest. The latter was not adherent to the skin. The condition had attained the above development in two months despite treatment.

Extensive œdema of the head sometimes occurs in the horse in petechial

fever and influenza, and in cattle in malignant catarrhal fever ; it also affects both the head and neck as the result of wounds in these regions. Where the head is held low for considerable periods, as after bruising or sprain of the muscles of the neck or disease of the cervical vertebræ, marked œdema may develop, completely transforming the appearance of the animal, while swellings affecting the nasal mucous membrane and adjacent structures induce difficulty in breathing. A photograph of such a case is presented in Fig. 306.

This condition demands attention, as, being often accompanied by fever, it may, on superficial investigation, be mistaken for a symptom of certain infectious disorders. Such an error is, however, avoided by consideration of the history of the case and the condition of the neck muscles, or the cervical vertebræ. Marked dyspnœa may necessitate tracheotomy. As soon as possible the head should be raised and so maintained by slinging the horse and employing a headrest. The result is often astonishing ; a large swelling of this kind disappearing in a few hours. Massage is useful to promote resorption of the transudation.

(D) DISEASES OF THE FRONTAL AND SUPERIOR MAXILLARY SINUSES.

Although in cases of empyema of the facial sinuses of the horse, the frontal and superior maxillary are chiefly involved, the other or smaller sinuses (inferior maxillary and sphenoid) are sometimes implicated. The superior maxillary sinus communicates with the middle meatus of the nasal chamber by a curved slit-like opening, which is very unfavourably situated and too small to give free exit to the usual purulent collection in the sinus. The inferior maxillary compartment in young horses is very small, and though larger in old animals it seldom contains pus. Normally it is separated from the superior or larger sinus by a transverse bony partition, which, in a few horses, is imperfect or perforated. This small sinus communicates with the nasal passage by a portion of the curved slit already mentioned. The frontal sinus has no direct outlet to the nasal chamber, but it communicates by a large opening with the superior maxillary sinus, so that impaction or disease of the frontal sinus nearly always affects the large maxillary sinus. In oxen the frontal sinus opens directly into the nasal chamber.

The mucous membrane of the frontal and maxillary sinuses is continuous with that of the nasal passages. In the sinuses it is closely attached to the bone, to which it acts as periosteum, and contains numerous small mucous glands. From its sheltered position this membrane is seldom primarily diseased. But when nasal infection or catarrhal inflammation arises, the disease readily extends and becomes chronic, and the exudate, finding no direct outlet,

accumulates in the cavity and decomposes, irritating the mucous membrane. This tendency to chronicity is induced by various causes.

On clinical grounds, diseases of the frontal and superior maxillary sinuses must be considered together despite their varying characters and causes. The following forms are recognised :—

(1) Dropsy of the sinus. A serous fluid fills one sinus or occasionally the sinuses of both sides of the head. There may be no marked change of the lining mucous membrane.

(2) Empyema of the sinus. The sinus contains pus; in acute cases and in oxen blood may also be present. The mucous membrane is thickened, vascular and covered with granulations.



FIG. 307.—Osteomata from skull of a three year old bullock.

(3) Tumour formation in the sinus. Carcinomata, sarcomata, osteomata, odontomata, &c., may be present, accompanied by varying quantities of a muco-purulent fluid. See "Tumours in the Facial Sinuses and Cancer of the Superior Maxilla," in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery."

(4) Specific inflammation due to glanders, botryomycosis, or actinomycosis. Glanders ulcers and specific new growths are accompanied by a purulent fluid.

The causes are as varied as the processes themselves. In the horse the superior maxillary sinus is often involved in consequence of suppurative alveolar periostitis attacking the socket of a molar tooth and the discharge escaping into and infecting the cavity. It may also suffer owing to the development of new growths or the entrance of foreign bodies. Finally, the sinuses may become affected

by extension of a disease like glanders, strangles, or catarrhal inflammation from the nasal mucous membrane.

Stockfleth found in this cavity a piece of bone, the result of unskilful trephining. Stenersen found pieces of sand-sedge, which had obtained entrance through the socket of a diseased upper molar. Decomposed food may enter in the same way. Fractures of the frontal and superior maxillary bones, and in cattle, injury of the horn-core, also act as causes.

Cadiot believes that chills due to cold external applications or cold irrigation of the sinuses may promote disease. *Estrus larvæ* are found in the nasal chambers of sheep and occasionally in the facial sinuses of horses.

In oxen the causes are usually fractures of the horn-core, or severe bruising and necrosis of bone due to the yoke. Tumours are rarer in oxen than in horses.

Vahey saw a three year old bullock with slight enlargement above the line of molar teeth on the left side, apparently involving the maxillary sinus. In four months the head increased to nearly double the normal size, and became much distorted. The left eye was almost closed, probably by a large osteoma within the maxillary sinus. On slaughter bony tumours were found "everywhere, all over the head." Professor Mettam examined the skull. The largest tumour was situated in the left maxillary sinus, and had protruded into the orbital cavity. The smaller of the two tumours illustrated (Fig. 307) was in the right maxillary sinus. Ten or twelve other smaller tumours were obtained from different parts of the skull, and one the size of the fist from the body of the inferior maxilla. This last was interesting because it had included within it at least one incisor tooth. A tumour was also removed from between the bodies of the premaxillæ, and one from the angle of the left ramus of the inferior maxilla. The three tumours last mentioned were attached to or included within the bones, but there "were no distinct pedicles." The bones in which they were situated were reduced to mere shells. The large tumours photographed were not pedunculated at all. Sections resembled ivory. The larger of two was 16.5 cm. in length, and 11 cm. in greatest width. It had a circumference of 40.7 cm. It weighed 4 lbs. 3 ozs., or nearly 2 kilos. The smaller tumour was 8 cm. in length, nearly 6 cm. in breadth, and weighed 12 ozs. (380 grammes). Part of the surface of the larger tumour resembled a growing coral. The remainder of the surface was bosselated. An irregular cavity in the interior was filled with decomposing animal matter. Although the osteoma was so hard and resistant to the saw, yet one half which

was accidentally dropped broke into three pieces; the fractures were clean and conchoidal, giving one the impression that this large tumour had resulted from the fusion of several of small size. The smaller tumour included in its structure a molar tooth.—*The Veterinarian*, March, 1899.

In sheep œstrus larvæ sometimes cause disease of the frontal and superior maxillary sinuses. In dogs tumours are the commonest cause, though *Linguatula tænioides* occasionally plays a part.

The diagnosis can often be made only by the method of elimination. The first symptom is a one-sided mucopurulent and sometimes ill-smelling nasal discharge, which may only appear at intervals or when the head is depressed, as in disease of the guttural pouch. If the disease has been caused through alveolar periostitis, the peculiar odour of a decayed tooth will be notable. The submaxillary glands of the same side often swell, and the case may be suspected to be glanders. At a later stage the bones inclosing the sinus become swollen, and on percussion over the diseased spot emit a less resonant sound. In making this test the horse's mouth must be closed, and the sinus on each side struck in turn over exactly corresponding points, using the plain end of the percussion hammer, or the points of two fingers. Thinning of the bone, so that it yields to strong pressure, is sometimes seen in cases of tumour growth and in actinomycosis or botryomycosis. Perforation or bulging of the bone is only seen in rare cases, and is generally due to tumour formation. In doubtful cases resort may be had to exploratory puncture by means of a gimlet.

In oxen the nasal discharge is usually blood-streaked at first, and only becomes purulent at a later period. If the frontal sinus be affected, signs of brain disturbance, like dulness, lowering of the head, giddiness, falling or staggering may appear. In unilateral disease the animal usually holds the head obliquely towards the diseased side.

Similar sensory disturbance is seen in dogs and sheep when the frontal sinuses are affected. Dogs are then apt to be very snappish.

Treatment must be preceded by trephining. Though two openings are not absolutely necessary in every case, it is usual to trephine both the frontal and superior maxillary sinuses. To provide drainage the superior maxillary sinus must be opened, but the only useful purpose served by opening the frontal sinus is to allow of the cavities being thoroughly washed out, which is very essential in all cases of empyema. Inhalations or insufflations are useless in impaction of the facial sinuses. The cases said to have been cured by disinfectant sprays or powders are open to considerable doubt.

After trephining, the contents of the sinuses are washed out by injecting a disinfecting solution, such as boracic acid, potassium permanganate, hydrogen peroxide, or iodine, and closure of the openings is prevented by inserting plugs of tow or jute, or corks. Irrigation must be repeated daily, until the nasal discharge ceases.

(E) TREPHINING THE SUPERIOR MAXILLARY AND FRONTAL SINUSES.

Trephining is resorted to in the treatment of empyema of the facial sinuses, necrosis of the turbinated bones, in removing tumours or foreign bodies from the nasal chambers or sinuses, and in punching out certain molar teeth.

Various instruments are used for removing portions of bone from the walls of the skull.

(1) The trephine, a circular-shaped saw, which is either affixed to a stock similar to a carpenter's (stock trephine, Fig. 308), or to a handle (hand trephine, Fig. 309). Usually the latter simple form is used. The crown, a steel cylinder of varying size, which forms the saw, is smooth on its external surface, differing in this respect from those formerly in use (trepans), which were conical, and provided externally with sharp saw teeth to allow of their entering the bone. In the centre of the crown stands the centre pin, a piece of steel which can be fixed by means of a screw, and caused to project somewhat beyond the cutting edge of the crown.

(2) A small gimlet to perforate the bone for the centre-pin of the trephine.

(3) The bone screw (Fig. 310) carries at one end a ring, by which it is held. The other end is fashioned into a conical screw, which can be used as a perforator, or to remove the disc of loose bone: under certain circumstances the screw may be used to bring depressed bone into its former position, but for this purpose the elevator (Fig. 310A) may be found more convenient.

(4) The lenticular knife (Fig. 312). With this the sharp edges of the opening left by the trephine are removed, to prevent the finger being injured when introduced during examination.

(5) The "periosteum knife" (Fig. 313) is for scraping the periosteum from the point of operation, but may be replaced by a blunt knife, curette or gouge. The set of instruments usually comprises a chisel (Fig. 311) and saw to remove pieces of bone such as those between two trephine apertures, and is useful in making large openings. Where a trephine is not to hand, the opening may be

made with an ordinary borer (exfoliative trephine, Fig. 314), but if it is merely necessary to make an aperture in the bone, the perforating trephine is used (Fig. 315). The last-named instruments can, however, generally be dispensed with.

The **superior maxillary sinus** in the horse is generally divided by a thin plate of bone into an upper larger and a lower smaller division. Lanzilotti describes this plate as having been present in 52 out of 74 cases operated on. It lies nearly in the centre of a rectangle,



FIG. 308.—Stock trephine.

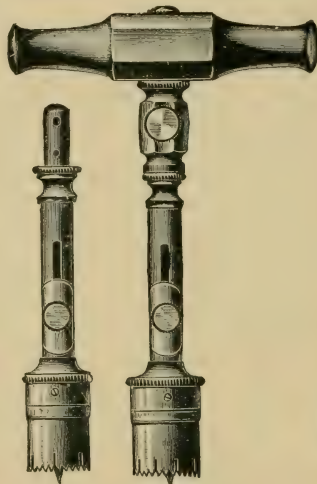


FIG. 309.—Hand trephine.



FIG. 310.
Bone screw.

whose longer sides are formed by the zygomatic ridge, and a line drawn parallel with it starting from the inner angle of the eye, and whose shorter sides are bounded by the rim of the orbit and a line drawn perpendicularly to the lower end of the zygomatic process of the malar bone (see Figs. 316 and 317). According to Lanzilotti, the septum is always wanting in the ass, and often in the mule. Trephining about $1\frac{1}{4}$ inches above the lower end of the zygomatic ridge, and $\frac{3}{4}$ to $1\frac{1}{4}$ inches away from it, this division is cut into, and both portions of the sinus are opened. Where one sinus alone has been opened, the dividing wall can be broken down. In young

horses one operates somewhat further from the edge of the zygomatic ridge, in order not to injure the roots of the molars which lie in the lower division of the superior maxillary sinus.

The horse had better be cast, though quiet animals may be operated on in the standing position. The hair should be removed from the seat of operation, which is then washed and disinfected. Anæsthesia is not necessary.

In trephining the superior maxillary sinus, the incision should be parallel with, and about 1 inch above, the zygomatic ridge. A "T" or "V" or "X" shaped incision was formerly recommended,



FIG. 310A.
Elevator.



FIG. 311.
Chisel.



FIG. 312.
Lenticular
knife.



FIG. 313.
Periosteum
knife.



FIG. 314.
Exfoliative
trephine.



FIG. 315.
Perforating
trephine.

but Gerlach rightly condemned this procedure, because the loose flaps of skin retract and give rise to excessive granulation. The late Professor Robertson recommended removing a circular patch of skin. Cicatrisation is much more perfect after this procedure, and in one or two months no visible wound remains. The skin is separated from the sub-lying tissues with the knife in order to make room for the trephine crown within the edges of the wound. Should the operation on the superior maxilla be performed rather higher than above described, the belly of the levator labii superioris is encountered, and must be pushed to one side. The trephine crown is now placed in position, and to facilitate removal of the pieces of periosteum a cut is made around it with a guarded bistoury, and

the membrane separated with a scraper or blunt knife. A central hole having been made with a gimlet, the trephine, with its centre pin in advance, is replaced in position, and by light rotary

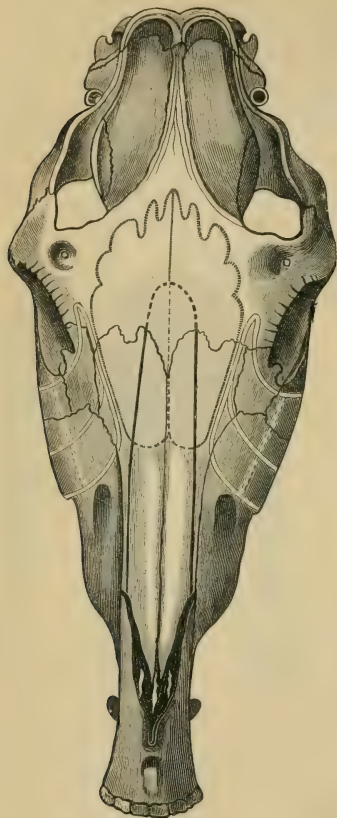


FIG. 316.—Head of a horse.

||||||| boundaries of the frontal sinus.
 ——— " " nasal meati.
 - - - - " " superior maxillary sinus.

movements caused to enter the bone. The instrument in case of need is supported by the thumb and index finger of the operator's left hand. The teeth of the saw soon make a groove, and when once the trephine has obtained a "grip" it should be turned in one direction until the bone is divided. Where the bone is very thick it will be necessary from time to time to clean the teeth of the trephine with a brush. An increased sense of yielding gradually becomes apparent, where-upon sawing is more cautiously proceeded with. As soon as the bone is cut through, the elevator is applied and the piece raised and lifted out. Frequently the disc of bone will be found fixed in the trephine and removed with it. The lining mucous membrane generally remains *in situ*, or hanging in shreds to the sides of the opening.

After removing sharp edges with the lenticular knife, the finger or a probe may be introduced for examination. Bleeding is usually

slight. In empyema, pus usually flows from the opening spontaneously, and whatever remains can be removed by washing. Afterwards the opening is closed with a plug of tow or gauze.

In opening the **frontal sinus** the bone is trephined at a point midway between the internal angle of the eye and the middle line of the frontal region. Here the skin lies almost immediately on the periosteum. A V-shaped incision, with the angle directed downwards, is made through the skin and periosteum, the flap of skin is turned upwards, and the periosteum is removed to an extent equal to the diameter of the trephine crown. With the gimlet an opening is made in the centre of the uncovered bone, then the trephine is

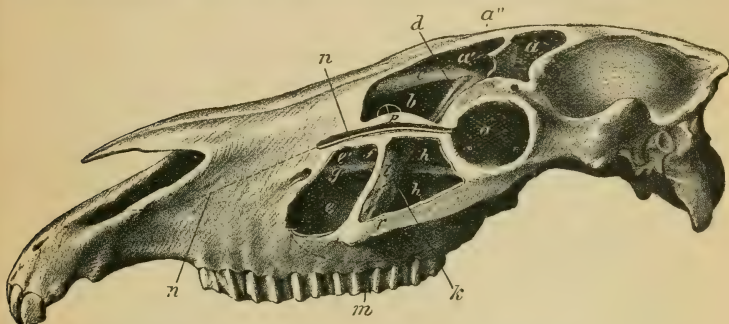


FIG. 317.—Lateral view of horse's skull; the facial sinuses exposed.

a, Posterior portion of frontal sinus; *a'*, anterior portion of same; *a''*, the septum dividing them; *b*, posterior portion of the anterior turbinated bone; *c*, cavity of nostril; *d*, ethmoid bone; *e*, superior maxillary sinus (lower part), which is divided from the upper part *hh* by the thin septum *i*; *e* bony plate forming the lateral boundary of the posterior turbinated bone *f*; *g*, infraorbital canal; *h*, line dividing the upper (thin) from the lower (thick) portion of the septum; *k*, lower margin of the maxillary sinus; *n*, nasal duct; *o*, orbit; *p*, zygomatic ridge.

applied, and the operation completed as described under trephining the superior maxillary sinus.

The opening should not be made too near the cranial cavity. A line connecting the right and left supra orbital foramina indicates the upper limit of the operation field. If the opening is made too high the trephine may damage the lateral mass of the ethmoid bone; besides there is no disadvantage in entering the frontal sinus at a lower point.

During the first three or four days after operation the artificial openings may remain blocked with blood or pus, but at the end of that time discharge occurs freely and recovery is usually easy.

After-treatment must depend on the nature of the disease. In chronic catarrh, flushings of the affected sinus with antiseptics like boracic acid, hydrogen peroxide, iodine, and carbolic acid, are

indicated. Where putrefactive processes are actively going on, 3 per thousand permanganate of potash, or solutions of astringent materials—such as alum 2 per cent., tannin 2 per cent.—may be used. The openings are then closed with plugs, so as to guard the mucous membrane against the direct influence of the air. Treatment should be continued as long as any nasal discharge is present. The wounds are afterwards encouraged to heal, only soft plugs being used in the trephine openings. In about three or four weeks they close completely, and after the lapse of two or three months scarcely a trace of the operation can be observed.

Where large tumours are to be removed from the frontal or superior maxillary sinus a single opening may not be sufficient; a second is bored in the neighbourhood of the first, and the intervening bone removed with the assistance of the chisel (Fig. 311) and the hammer. Möller has frequently had occasion to trephine the nasal roof in this way in order to remove tumours or necrotic portions of the turbinated bones. A saw similar to a key-hole saw is useful here in order to enlarge the trephine opening.

To facilitate drainage Siedamgrotzky suggested a modified method of operation. He operated about $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in front of a horizontal line drawn through the two inner angles of the eyes, and $1\frac{1}{4}$ to $1\frac{1}{2}$ inches from the middle line of the face. After washing out the sinus cavity he effected a communication between it and that of the nose by thrusting a director downwards and inwards at the deepest spot, breaking through the thin plate of bone and the mucous membrane covering it, and enlarging the opening so made by excising with a tenotome an oval fragment $\frac{3}{4}$ inch long and $\frac{3}{8}$ inch wide. To avoid injuring the septum nasi the knife is only introduced a short distance and the operation performed at the deepest spot. The resulting bleeding ceases in a few minutes; if not, the cavity may be plugged. To prevent inspiration of blood the horse is at once allowed to rise; for a similar reason anæsthetics are withheld.

Although diseases of the frontal sinuses occur in cattle, they are less common than in horses. In sheep, on the other hand, the presence of œstrus ovis may necessitate the opening of the frontal sinuses. This is usually done in the middle line, in order that both sinuses can be opened simultaneously, and washed out by injections. The frontal sinus, as in other ruminants, is connected with the horn-core, and may be opened by sawing through the horns; but this operation is not only more painful, but is also accompanied by greater loss of blood, which in animals already weakened may be attended with undesirable consequences.

(F) NECROSIS OF THE TURBINATED BONES.

After Jessen's description of a peculiar disease of the turbinated bones of the horse, accompanied by chronic thickening, Stockfleth and others published descriptions of similar cases. The condition is not common in North Germany, and usually appears after strangles, while a few cases of Möller's have been caused by disease of the upper molars. Sand, on making the post-mortem examination of an old horse which had shown an offensive nasal discharge, found the mucous membrane was thickened, and the surface of the ethmoid cells necrotic. The bony plates had broken down, forming a grey, grumous material. Möller has seen two cases caused by disease of the upper molars, and Fröhner published three of a similar kind.

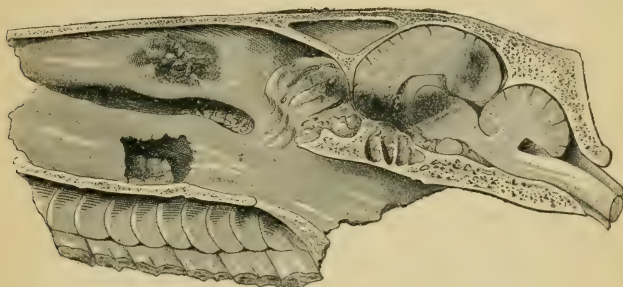


FIG. 318.—Necrosis of the turbinated bones.

For a very full description of this condition see Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery."

Sand describes a peculiar disease of the turbinated and neighbouring bones which he terms mucoid degeneration (*schleim-degeneration*). The disease was seen oftenest in foals, and was distinguished by dyspnoea, swelling of the bones of the face, and a muco-serous discharge. The post-mortem showed the bones of the face to be much thinned, partly perforated, and the sinuses of the head greatly dilated. The remains of bone structure in the turbinated bones could only be recognised microscopically; the latter appearing to be almost transformed into a mucoid tissue. The walls of the superior maxillary and frontal sinuses showed the same changes, and the cavities themselves were greatly increased in size. Their contents were sometimes purulent, sometimes muco-serous.

The early **symptoms** consist of a stinking discharge from one nostril, snoring breathing, and diminution in the stream of air of the affected side. At a later stage the nasal bones become swollen, and not unfrequently the thickening in the turbinated bone can be

directly seen, or felt by the finger. As swelling of the pharyngeal glands is usually present, the condition is sometimes difficult to distinguish from nasal polypus, and is occasionally only recognised exactly after trephining.

Treatment. Trephining the nasal cavity and removal of the diseased turbinated bone is the only method likely to prove successful.

Cadiot and Dollar describe removal of the posterior (maxillary) turbinated bone. The left nasal cavity was trephined, an incision about $\frac{3}{4}$ of an inch long being made opposite the centre of the nasal bone; at each end two circular trephine openings were made and the intervening bone removed with scissors. The anterior part of the diseased bone was removed through an opening in the left false nostril and the remainder through the trephine incision. In four weeks recovery was almost complete. Höyer, in a case of necrosis of the turbinated bones, removed the diseased part with a muscle hook and secured healing, whilst the cases described by Jessen were also cured by resection of the diseased turbinated bone through a trephine opening. Hering and Jessen recommend making an incision through the skin close to the middle line, and extending the entire length of the nasal bone. At the upper end of this cut the trephine is inserted, and a piece of the nasal bone an inch broad and as long as the cut through the skin removed by a key-hole saw. Through such an incision the diseased turbinated bone could also be removed. But a case of caries treated in this way by Möller was still uncured after the lapse of eight weeks. Complete resection of the turbinated bones is attended with no slight difficulty; any fragments left behind are apt to continue the disease. Schlegel described a case in a horse of osteosarcoma of the left lower turbinated bone, which eventually led to pulmonary gangrene and metastatic growths, endocarditis, gastritis ulcerosa, and tendovaginitis of the flexor tendons of both hind-legs. The animal died. A horse treated by Cadiot for necrosis of the turbinated bones died of consecutive meningitis and pyæmia.

Sand recommends, in cases of mucoid degeneration of the turbinated bones, to trephine early, and having established free drainage, to wash the parts out regularly with antiseptic solutions. This is said usually to check or completely cure the disease. A four-year-old mare was sent to hospital after suffering for some weeks from ill-smelling nasal discharge. She was well-nourished, and had no appearance of bodily illness, but an offensive muco-purulent discharge, smelling of bone pus, was discharging in moderate quantities from the left nostril; the submaxillary glands of the left side were somewhat swollen. The use of Günther's catheter disclosed the existence, on the floor of the left meatus, of a slight unevenness and swelling at the height of the third molar. The resulting examination of the mouth disclosed the fact that the third upper molar on the left side had lost its crown, and that all the appearances of purulent periostitis of the alveolus existed. Scars left by the previous trephinings were visible on the temporal and superior maxillary bones of the left side. After removing the diseased tooth by punching, the operation wound healed regularly, but the nasal discharge continued. Trephining the nostril was undertaken, when it was found that the turbinated bones were necrotic, and denuded of mucous membrane at several points. Attempts to remove

these portions were not successful ; and on account of the comparatively small value of the horse, the owner decided to have it killed.

Necrosis of the cartilage of the nostril is described by Cadiot and Dollar. The inner wing of the nostril was swollen and indurated over the region corresponding to the cartilaginous plate, with which a sinus, masked by granulations, communicated. This sinus was laid open and the parts swabbed with iodine tincture. Treatment was intermittent and a second operation became necessary, but recovery occurred in four months.

(G) EPISTAXIS (BLEEDING FROM THE NOSE).

Bleeding from the nose may occur spontaneously without local injury or disease, or as a symptom of disease of the mucous membrane, as in ulceration, wounds and tumours.

Extensive venous plexuses (*centrum venosum*) exist in the mucous membrane of the nostril of the horse, and especially in that investing the *septum nasi*. Injuries of these plexuses may give rise to considerable bleeding. Hence nasal bleeding is most frequently seen in this animal. It may be caused by external injuries, by fracture of the nasal bones with dislocation of the fragments internally, by other accidental wounds, occasionally from foreign bodies and tumours in the nostril. Schindelka noted severe bleeding after fracture of the septum. In a fifteen-year-old horse, which for ten years had suffered periodically from epistaxis, especially after severe exertion, Deigendesch found an angioma of the septum which had become ulcerated. Great exertion, like racing, sometimes occasions bleeding, as do dusty, irritating fodders. Bigoteau observed nasal bleeding in a great number of horses which had been fed with dusty sainfoin. It is further noteworthy that ulcerative changes like those of glanders give rise to repeated bleeding, which is also liable to occur in mercurial poisoning. The quantity of blood so lost, and the time of bleeding, are exceedingly varied. Nasal bleeding also occurs in anthrax and purpura.

Diagnosis is not usually difficult ; though sometimes the source of the blood may be in doubt. In hæmoptysis, the blood is frothy, and escapes by both nostrils in the horse, and by the mouth as well in some animals ; and there are other symptoms, such as cough, dyspnœa, noisy, rapid respiration. In bleeding from the stomach, the blood is ejected by the mouth and nose in dogs and cattle, and it is more or less altered, being black, coagulated, or in masses.

Treatment. Immediately bleeding becomes of a character to require therapeutic treatment, cold applications are made to the head, and the nostril of the affected side washed out by means of the irrigator, with cold water, to which tannin or vinegar may

appropriately be added. In one-sided bleeding from the lower portion of the nostril, plugging may be necessary, but where this is resorted to the patient must be carefully watched, and the plug secured by tape; or tracheotomy can be performed, a tampon cannula inserted, and both nostrils plugged. Even this, however, will not invariably stop the bleeding. Insufflation of finely powdered alum has been recommended, and is worth trying when the blood comes from the lower portions of the nostrils. Where fatal results threaten, ergot or adrenalin may be tried. Sohngen saw recovery in the horse after subcutaneous injection of 12 grains extr. secal. cornut. Extractum hydrastis canadensis is useful, but adrenalin chloride is now the best hæmostatic for bleeding from mucous membranes. Astrachanez plugged the nostril with tampons of tow saturated with turpentine, and injected turpentine into the nostril with success.

In spontaneous bleeding in race horses considerable success has attended the hypodermic injection of solution of adrenalin chloride. Although fatal bleeding has been repeatedly observed in horses, the flow usually ceases when the animal is kept quiet, and when hæmorrhage has lowered blood pressure. The head should be kept elevated.

IV.—DISEASES OF THE SALIVARY GLANDS.

(1.) WOUNDS AND INJURIES OF THE SALIVARY GLANDS.

OWING to the position of the parotid it suffers from external injuries more frequently than the other salivary glands. As long as important blood-vessels are not injured, wounds of this gland are not particularly serious. If proper treatment be adopted at once, even the danger of salivary fistula is not great. The injuries most to be feared are those in which the ducts of the gland, and especially Stenson's duct, are injured. In sheep and dogs Stenson's duct passes obliquely across the cheek, while in horses and cattle it partly lies protected below the jaw, and hence is less exposed to external wounds. The duct is more frequently injured by sharp objects. The condition may be recognised by the position of the wound, and the outflow of clear saliva, the secretion of which is increased by feeding, and even by the sight of food. In many cases the wounds heal completely; in others a small opening is left from which saliva discharges (salivary fistula). To avoid this result, healing by first intention must be sought for; the flow of blood checked, the wound carefully cleansed and sutured: during twenty-four to forty-eight hours the

animal should receive no food, and should be placed by itself in order that the secretion of saliva be not excited by the feeding of its fellows. Small doses of atropine may also be given to check or altogether stop salivary secretion. Further treatment must be based on the general principles of surgery.

(2.) INFLAMMATION OF THE SALIVARY GLANDS (PAROTITIS).

The salivary glands at times become the seat of inflammation. The parotid is most frequently affected, the submaxillary and sublingual only occasionally. Foreign bodies obtaining access to the glands may produce inflammation. But many cases result from causes not clearly recognised, some of them apparently of an infectious nature. They produce their effects either by irritating the gland ducts directly, or through the blood stream. In men, as in animals, endemic parotitis sometimes shows itself. That in man is clearly of an infectious character, and is vulgarly known as mumps. Animals, and especially dogs, suffer from a similar disease. Not infrequently parotitis appears symptomatically during the course of equine strangles and influenza, and of distemper in dogs, and it has been seen repeatedly in cats.

The inflammatory condition arises in the parenchyma of the gland. The organ swells, its divisions appear dark red, and their epithelium turbid in small areas. The process soon spreads to the connective tissue which, after a short time, is infiltrated with lymph. Finally pus formation takes place both here and in the alveoli. By confluence of small abscesses greater ones are formed, extensive areas of the gland and its connective tissue become necrotic, and the abscess finally perforates, not infrequently destroying a large piece of skin. Not all abscesses in the parotid region are necessarily due to parotitis; many are only subparotideal, but perforate by way of the parotid. The abscesses in this region seen in swine and oxen mostly originate in the pharynx. In oxen the foreign body causing the abscess may often be detected by exploring the abscess cavity with the finger.

Symptoms and course. Acute parotitis, the most frequent disease of this kind, is accompanied by the early appearance of a diffuse swelling in the parotid region. The gland appears hard, hot, and painful; the head is extended, and inclined towards the sound side. When the swelling is great, dyspnœa and difficulty in swallowing may be present. At times facial paralysis is produced

owing to pressure on the nerve, or to extension to it of the inflammatory process. The swelling gradually becomes fluctuating at its most prominent point, and if not opened a large quantity of ill-smelling greyish-red fluid, mixed with flakes of dead connective tissue will be spontaneously discharged. Once necrosis has taken place, abscess formation usually results in eight to ten days; but in fourteen days to three weeks complete healing may be expected. Recovery is the most common termination; but owing to high fever and disturbance of appetite the animals fall off in condition, and milk secretion abates. Salivary fistula and facial paralysis are seldom observed as sequelæ of this affection. In a case of Möller's the optic nerve was involved and optic paralysis with amaurosis remained, having evidently resulted from retrobulbar neuritis, produced by extension of inflammation into the orbit.

Differential diagnosis. Parotitis may easily be mistaken at the commencement for swelling of the sub-parotideal lymph gland, which however, is more diffused. From distension of the guttural pouches parotitis is distinguished by the presence of inflammation, and by the absence of intermittent nasal discharge which is so diagnostic of disease of the guttural pouch. Tumours in the parotid region are unaccompanied by inflammation, and never develop so rapidly as the swelling of parotitis. The submaxillary and sublingual glands also become diseased, but less frequently. Inflammation of these glands usually originates in the mucous lining of the ducts, the process extending from catarrhal conditions of the buccal membrane. Outbreaks of an enzootic type are recorded in horses. A long flattish swelling appears in the throat, which extends under the parotid, and salivation is present. The termination of Wharton's duct on the floor of the mouth appears stopped. Should pus formation result, the abscess commonly breaks into the mouth, less frequently externally, but in fourteen days convalescence is established. The abscesses so often seen in the laryngeal region in oxen are almost always the result of injury to the tongue or lower portion of the cavity of the mouth and local infection.

Stockfleth has described, under the name of "ranula," a disease in cows which presents the appearances of virulent inflammation of the submaxillary gland. There is œdema of the throat, and an elastic swelling as large as a hen's egg is found at the frænum linguæ. If this be opened early, the symptoms soon disappear, but if not, the head and neck rapidly swell, and breathing and swallowing are so disturbed that the animals often die in a few days.

Inflammation and abscess formation occur in the ducts of the

salivary glands, especially in Stenson's and Wharton's ducts. Meyer found in Stenson's duct in a horse a spikelet of Timothy grass. Concretions may also inflame the gland duct, producing pus formation and salivary fistula. Foreign bodies in the duct can often be removed by pressure in the direction of the buccal opening; if this fail the duct must be incised.

Thiernesse described a disease in dogs similar to parotitis, but withstanding all ordinary curative methods, and for which he recommended complete extirpation of the gland. In similar disease occurring in horses, the same surgical treatment must be adopted. A case of chronic inflammation of the submaxillary gland in a horse occurred in Möller's clinique. The swelling appeared slowly in the region of the larynx, produced perforation and a permanent fistulous wound. A long, painful induration was found extending upwards in the course of the submaxillary gland, and a fistulous opening below in the throat, from which a canal ran throughout the greater part of the swelling. Healing was effected by passing a seton needle upwards through the swelling, making an opening and inserting a drainage-tube.

Treatment. Owing to the character of acute parotitis, cold applications are usually contra-indicated; while warmth, in the form of Preisnitz's poultices, inrubbing of camphorated oil, and warm applications, are to be recommended. Warmth either leads to dispersal of the swelling or hastens abscess formation, and, in any case, shortens the progress of the disease. When marked fluctuation appears the part should be opened, but this may be needful earlier if dyspnœa threatens; and where breathing is much interfered with, tracheotomy becomes imperative. In ordinary circumstances distinct fluctuation is waited for, thus avoiding the danger of the incision wounding large blood-vessels or nerves, and of producing salivary fistula. Caution is required in employing the often recommended trocar, for injuries to large blood-vessels and considerable bleeding are not altogether avoided, even by its careful use. As the contents of the abscess are often under high pressure, and spurt out in a stream, Stockfleth recommended making the opening from the opposite side, and standing on a block of wood during the operation. The method described in the next section is preferable.

With chronic parotitis, little can be done. Cattle should be prepared for slaughter without delay, because difficulty in breathing and swallowing often appear later, and make feeding absolutely impossible. Abscesses should be opened and their cavities washed out with 10 per cent. chloride of zinc, or similar disinfectant. In valuable animals, or such as have no slaughter value, total extirpation of the parotid may be adopted. In acute inflammation of the sub-

maxillary gland and in chronic diseases, extirpation of the gland may be necessary, but is attended with great difficulty, especially in ruminants. In inflammatory diseases of the ducts of these glands endeavour should be made to render patent the buccal opening of the gland, give exit to its contents, and thus diminish the risk of abscess and fistula formation.

(3.) ABSCESS FORMATION IN THE SUBPAROTID LYMPH GLANDS.

The lymph glands lying below the parotid often become diseased, especially during the course of strangles, sore-throat, and other complaints, inflammation developing, and gradually leading to abscess formation. In dogs the condition is oftener due to injuries of the pharynx by foreign bodies; in cattle and swine to specific infections, like those of tuberculosis and actinomycosis.

Symptoms. Swelling appears in the parotid region, sometimes close under the ear, more frequently, however, in the lower posterior border of the gland, and usually spreads over the upper portion of the neck. The swelling increases, producing difficulty in breathing and swallowing, while the head is extended and held towards the sound side. Slight fever exists. Where both sides are affected, dyspnœa often develops to such a degree, especially during inspiration, that suffocation threatens, and tracheotomy becomes necessary. The difficulty in swallowing is attended by the danger of mechanical pneumonia.

At first the swelling appears hard and firm, and painful on pressure. Gradually the centre bulges, and in eight to fourteen days unmistakable fluctuation may be detected. Failing an artificial opening, perforation occurs spontaneously in a few days. This commonly takes place externally, but at times the abscess breaks into the pharynx, and danger ensues of pus flowing into the trachea and bronchi, and producing fatal pneumonia. In a few cases rupture takes place both inwardly and outwardly. From the external wound there then flows pus, mixed with necrotic material, saliva and particles of food and water, and the formation of a pharyngeal fistula becomes possible.

Diagnosis. The disease in the horse resembles parotitis and distension of the guttural pouch. From parotitis it is distinguished by the swelling being more diffused, and not confined to the parotid region; from disease of the guttural pouch, by the special characters of such attacks, by the progress of the case and the presence of fever.

Treatment. Early opening of the abscess is desirable, but the use of sharp instruments for the purpose is contra-indicated, as, owing to the displacement of parts, the parotid may be wounded, producing salivary fistula, or the great blood-vessels injured, causing fatal bleeding.

Viborg describes the following excellent method, which is simple and without danger. A twitch having been applied, and the seat of operation cleansed and disinfected, an incision is made through the skin over the highest point of the swelling, and if possible, below the edge of the parotid, the underlying fascia divided, and the forefinger inserted. The thick connective tissue or gland structure is now broken down, the free hand meanwhile pressing on the swelling and guiding the inserted finger towards the abscess. This attained, a strong thrust breaks it and allows the escape of a stream of thick creamy pus, which often spurts to a distance of several yards. It may be necessary to operate on both glands. Some operators prefer to make the incision at the lower border of the parotid, below the submaxillary vein. The finger is then passed upwards and inwards; sometimes the abscess can only be safely opened by using closed round-pointed scissors, as the tissue is very resistant. This method gives equal security against injuring the parotid or important vessels, and gives a depending orifice.

With drainage of the abscess, fever falls, and difficulties in breathing and swallowing disappear. Healing occurs in eight to fourteen days, but complete closure of the abscess sometimes requires from three to six weeks. Warmth and moist applications (Preisnitz's poultices) appear to favour the breaking down of the swelling; the pus is removed by pressure and washing out the cavity with carbolic or sublimate lotion; further treatment is not usually necessary. This procedure, as already stated, is preferable to the use of sharp instruments, and especially to the oft recommended trocar. Cadiot and Dollar describe a case of "cold abscess" in this region which had existed for three months. A little inodorous whitish mucous discharge ran from the nostrils. A swelling occupied the submaxillary and laryngeal regions and extended on either side of the parotid. Swallowing was difficult, and the animal ate and drank slowly. The swelling was opened as above described, a pint of whitish laudable pus evacuated, and a drainage-tube inserted. Recovery was rapid. ("Clinical Veterinary Medicine and Surgery," p. 336.)

(4.) SALIVARY CALCULI AND CONCRETIONS.

Calculus deposits are sometimes encountered in the ducts of the salivary glands, especially of the parotid, in horses and cattle, and may attain the size of a goose's egg. They are commonest in the horse, ass, ox, and sheep. Schumann discovered one in a horse which weighed over 7 ounces, and Stockfleth a similar one of $12\frac{3}{4}$ ounces, but calculi have been found weighing 75 ounces. Their form is oval, colour greyish-yellow, surface usually smooth, though where several are together they show facets. In herbivora, according to Lasaigne, they consist of 80 to 90 per cent. carbonate of calcium, 3 per cent. phosphate of calcium, and 9 to 10 per cent. of organic substances, composed chiefly of salivary corpuscles and bacteria. In men and carnivora, phosphate of calcium is an important ingredient. Foreign bodies entering the salivary duct, or injuries of the mucous membrane, are the usual immediate causes. The cut surface of such concretions often presents a stratified appearance, and a central nucleus of oat-grain, awn, glume, or straw.

Symptoms. The concretion is only remarked after it has attained a certain size. It appears as a hard, sharply defined, slightly movable swelling, generally lying on the outer surface of the under jaw, slightly below the buccal opening of Stenson's duct, but sometimes over the posterior border of the under jaw. The salivary duct is usually distended behind the swelling, and when the flow of saliva is entirely shut off the gland is enlarged. Inflammation is seldom present, but may appear and lead to abscess formation.

Treatment consists in operative removal. Small concretions may perhaps be forced through the duct, which will necessarily be somewhat fissured; the larger require an incision to be made in the duct. In this case a transverse cut is preferable to a longitudinal one, on account of its healing more easily, and not so frequently leading to salivary fistula. Recovery is hastened by observing strict antiseptic precautions before and during operation, carefully suturing the wound, and withdrawing food for one to two days. Bayer removed a concretion from the duct through a longitudinal incision, and after closing the wound with Lembert's suture, effected healing by first intention. In some cases, where the calculus is lodged very near the opening of the duct, it may be removed by incision from the buccal cavity. Such cases are rare, but the fact is worth remembering, as this method avoids the occurrence of a salivary fistula.

(5.) SALIVARY FISTULÆ.

Wounds of the salivary glands and their ducts often fail to heal, because the continual flow of saliva pushes aside the granulations and hinders closure. The gland epithelium finally unites with that of the outer skin, and through the opening so formed saliva flows continuously (salivary fistula). A distinction must be made between fistula of a salivary gland and that of a salivary duct. The latter occurs most frequently in Stenson's duct. Although the general condition of the animal is only slightly affected, much saliva escapes during eating and mats the hair of the cheek, finally producing a blemish. Fistulæ of salivary glands heal more easily than those of salivary ducts,—sometimes, indeed, without treatment of any kind.

Treatment aims at closing the external opening. This may be done in fistula of the gland by cauterising with nitric acid, silver nitrate, concentrated carbolic acid, or the actual cautery. A scab is thus formed, which checks the outflow of saliva, allows the formation of granulations, and promotes cicatrisation. These methods sometimes fail at first, and require to be repeated. The draw-purse suture may prove useful.

The treatment of fistula of the salivary duct is more difficult. Before recovery can take place, it is necessary to provide for the passage of saliva into the mouth. Where stricture of the duct occurs, as it often does, at a point between the fistula and the natural opening, this must be remedied. Lindenberg recommends passing a strong probe, and then attempting to reclose the walls of the fistula by caustic or the cautery. The resulting inflammatory swelling may close the wound, but healing will be more assured if a stitch be inserted. The purse-string stitch is the best. With a strongly curved needle a thread is passed through the skin around the opening of the fistula, and the margins thus brought together. Where the natural opening into the mouth cannot be renewed, an artificial conduit must be provided. Stockfleth recommends exposing the duct behind the fistula, and piercing the cheek in an oblique direction with a trocar. The free portion of the salivary duct is introduced into this opening, and made fast with a suture. Lafosse and Hering passed a tape through the cheek by means of a trocar, and fastened the ends together at the commissure of the lips. After the thread has remained in position for a week or long enough to establish an artificial opening into the mouth, it is removed, and the external wound is then closed with a suture. Should this procedure be inapplicable, or not attended with success, destruction of the function

of the gland alone remains. For this purpose one of the following methods may be adopted :—

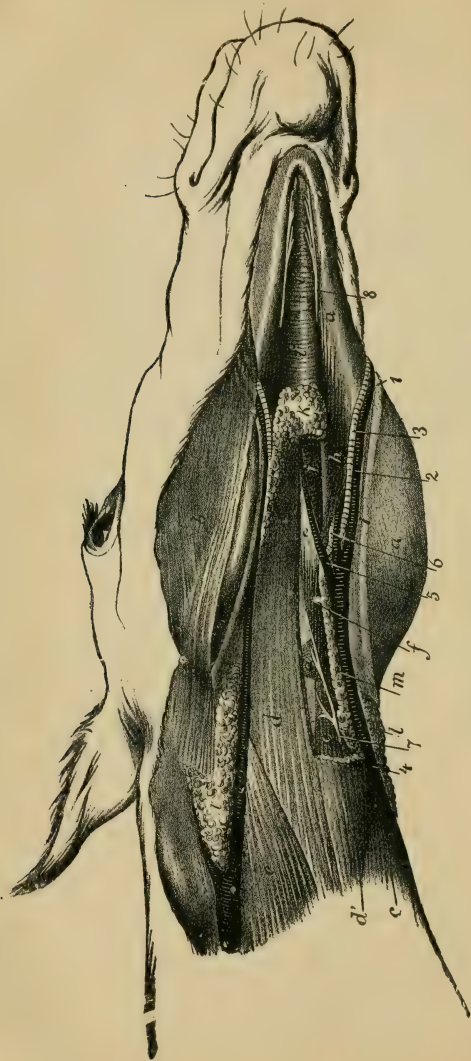


FIG. 319.—Infero-lateral view of the laryngeal region.

aa, Lower jaw ; *b*, panniculus ; on the other side it has been completely removed ; *cc*, sterno-maxillaris muscle ; *d*, sterno and omohyoideus ; on the other side *d'* it has been removed ; *e*, hyoid bone ; *f*, hyo-thyroideus ; *g*, crico-thyroideus ; *h*, digastricus ; *i*, mylohyoideus ; *i'*, myloglossus ; *k*, parotid gland ; *l*, submaxillary lymphatic gland ; *m*, submaxillary salivary gland ; *1*, Stenson's or Steno's duct ; *2*, 3, submaxillary artery ; *2*, 4, submaxillary vein ; *5*, lingual vein ; *6*, sublingual artery ; *7*, branch from the first cervical nerve ; *8*, mylohyoid nerve. (After Ellenberger and Baum.)

(1) **Ligation of the salivary duct above the fistula.** The duct is isolated between the fistula and the gland, and tied with a stout thread. A strong ligature is essential. The animal should fast for the next twenty-four to forty-eight hours, and then receive only fluid nourishment. Soon afterwards swelling of the gland appears (tumour salivalis), and is followed by gradual atrophy. Not infrequently, however, the ligature cuts, to prevent which a thick

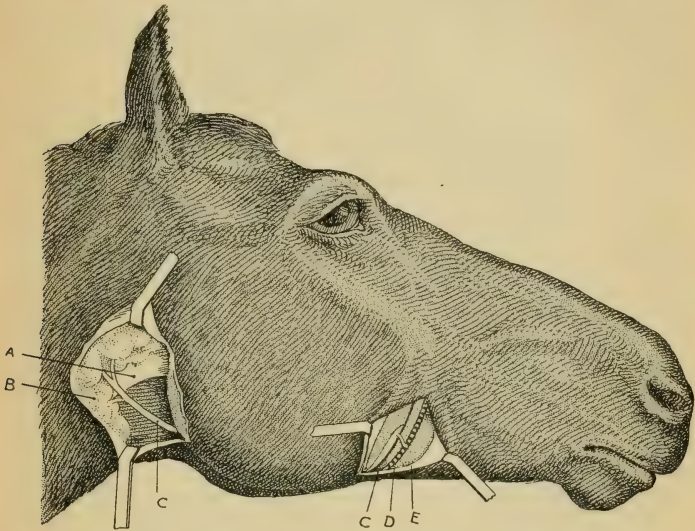


FIG. 320.—Parotid gland and Stenson's duct. (Semi-schematic.)

A, Tendon of the stylo-maxillaris; B, parotid gland; C, Stenson's duct. The lines D and E should be prolonged. They are intended to point to the facial vein and artery—the latter indicated by the strong cross-shading, the vein being next it towards the left.

ligature should be chosen. Bassi observed great dilatation of Stenson's duct after ligation; he applied a second ligature above the swelling, but a fistula of the salivary duct resulted. He then injected 6 drachms of ethyl alcohol into the gland on two occasions, at intervals of two days. The function of the gland was destroyed and the fistula healed.

(2) **Transverse section** of the duct, after being tried by Reynal and F. Günther, was again recommended by Gerlach, while Siedamgrotzky and Harms have also tested it, though Harms has questioned its usefulness. They found that the end of the duct became closed

through inflammatory processes, and that the duct itself afterwards atrophied. Even this method, however, sometimes fails.

Harms very appropriately points out that experiments, although successful on healthy horses, do not demonstrate the efficacy of similar treatment in diseased ones. Reynal found that it was not always possible to produce adhesion of the duct by section. The fact must not be lost sight of that in fistula of the salivary duct the opening of the duct into the mouth is generally occluded. Permanent closure of the duct gradually leads to atrophy of the parotid. Möller saw a horse in which the right Stenson's duct was dilated to the thickness of a man's thumb, and was without opening into the mouth. The gland had entirely disappeared, and the parotid region presented a marked depression.

(3) **Injection** of irritant fluids into the gland. Haubner recommended liquor amm. caust. 10 to 15 per cent. Tincture of iodine, creosote, nitrate of silver, &c., have since been used. Bassi injected 30 per cent. of alcohol; Labat the following mixture,—20 to 40 per cent. of tincture of iodine, 1 per cent. iodide of potassium, and 60 per cent. of water; Delamotte, 50 per cent. tincture of iodine; Bergeron, a 20 per cent. solution of lactic acid. Concentrated tincture of iodine usually produces severe inflammation of the gland, sometimes ending in necrosis, and therefore diluted solution of iodine in iodide of potassium is to be preferred. The injection can be repeated if necessary. Abscesses often result, but in no way interfere with success.

(4) **Extirpation** of the parotid gland is effectual, but the operation is difficult and not free from danger. The horse, cast on the opposite side, is anæsthetised, and the head and upper portion of the neck are placed on a cushion so as to increase the prominence of the operation field, which is washed, shaved and disinfected. The skin and parotido-auricularis muscle are incised in the middle line from the base of the ear to below the glosso-facial vein; and the edges of the skin are detached from the parotid in front and behind and at both extremities of the incision. To avoid injury to the numerous important blood-vessels and nerves, the operation should be continued by blunt dissection, employing the fingers, spatula, or closed scissors. Degive advises beginning at the upper extremity of the wound by ligaturing and dividing the posterior auricular vein; then detaching the anterior border of the gland from above to below, and isolating the jugular vein from its connection with the parotid. Next dividing the gland into two parts: an inferior which is detached from above to below, and a superior which is dissected from below to above, proceeding carefully in order to avoid damaging the external carotid artery, its two terminal branches (external maxillary and temporal),

and the posterior auricular artery; the facial nerve and its three auricular branches, and the superficial temporal nerve; and the guttural pouch, which lies beneath the upper extremity of the gland. Finally, the wound is douched with a weak antiseptic, powdered with iodoform and tannin, covered with a thin layer of absorbent cotton, closed with catgut sutures, and protected with an antiseptic compress and a roller bandage.

(6.) TUMOURS OF THE SALIVARY GLANDS.

The nature of new growths occurring in the salivary glands of animals has not hitherto been fully or sufficiently investigated. In man, connective tissue tumours, such as sarcomata, fibromata, and enchondromata, are most frequent. The tumours so common in grey horses are usually melano-sarcomata, and in cattle actinomycotica. As little is known of the causes of these new growths as of other tumours. Cohnhein refers the development of enchondroma to cartilaginous fragments of the branchial arch. Actinomycosis depends on infection.

Their sharply defined appearance, slow development, and the absence of inflammatory symptoms, render the diagnosis of tumours comparatively easy. Their precise nature, however, can usually only be determined by microscopical examination. Actinomycosis will be referred to later.

Treatment must clearly be of an operative character. Simple, sharply defined tumours can easily be removed with knife or scissors. By careful suturing and appropriate treatment of the wound, it is easy to avoid producing salivary fistulæ. Large and extended tumours may necessitate removal of the entire gland. Total extirpation of the parotid is attended with danger, and therefore should only be resolved on in case of pressing necessity, as when dyspnœa is produced by the tumour, or when exceptionally valuable animals, which must not be slaughtered, have to be dealt with. Leblanc is said to have first performed this operation, and to have employed it both for removal of tumours and for the cure of salivary fistulæ. The operating place should be well lighted, and aseptic precautions are, of course, necessary. Operation may be carried out by the method described under "salivary fistulæ," or as follows:—

The skin is divided from the upper to the lower end of the parotid, and where adherent to the tumour, is removed. In large animals a second incision is usually carried in a backward direction perpendicular

to the former, and starting from about its centre. The fascia underlying the skin is divided and separated as far as possible from the parotid. The gland, thus exposed, is now separated from its surroundings, beginning at the lower end, so that large bleeding vessels may be more easily dealt with. For the same purpose a thread may be passed around the carotid, which, in case of need, can be used as a ligature. As the recurrent nerve may easily be injured it is better, in valuable horses, to avoid exposing the carotid. The gland should as far as possible be separated with blunt instruments, assisted by the fingers. Vessels are ligatured as exposed, the larger doubly ligatured and then cut through. In this way, and by free use of sponges or dossils of lint, the field of operation is kept clear, and the gland removed without dangerous bleeding. The wound is then cleansed with antiseptic fluids, dusted with iodoform, covered with jute or wood wool, and the edges brought together with sutures. In twenty-four to forty-eight hours the stitches are loosened, the dressings removed, the wound washed out, dusted with iodoform and tannin, and the whole treated as an open wound. Healing should be complete in three or four weeks. If during the next few days portions of the wound appear damp, they should be dried with wadding, and powdered with a mixture of iodoform and tannin (1—3). Where a dry scab has formed, the wound is better left undisturbed. Dry scabs, firmly adherent to the underlying tissues, should under no circumstances be removed.

(7.) ACTINOMYCOSIS IN THE PAROTID REGION.

Although actinomycosis of the parotid region is also occasionally seen in horses and swine, it is very much commoner in cattle. By proliferation of the connective tissue new growths are slowly formed in the subparotideal and retropharyngeal regions. These were formerly erroneously regarded as tumours. Their true cause is to be sought in local infection with the actinomyces or ray fungus.

The fungus is probably taken in with the food, and finds entrance into the mucous membrane and deeper-lying tissues through wounds caused by the rough character of the food. The circumstance that herbivora most frequently suffer from the disease, supports the theory that infection results in this way. Johne detected vegetable material invaded by actinomyces in the tonsils of swine; Grawitz in the lower jaw of a calf found portions of a head of corn, which were surrounded by granulation tissue. Bang found the disease more

widely distributed where much barley straw was given as food. Fischer describes a wound of the human tongue produced whilst chewing some barley; ray fungi were found in the abscess which resulted, and the portions of grain discharged were also covered with them. According to Imminger, epizootics of aphtha favour infection, for he found that after these actinomycosis broke out over large areas. Frick considers that the fungus is often carried by the fodder, in proof of which he relates the following:—As a protection against anthrax certain farmers in his practice were in the habit of thoroughly steaming all cattle food before giving it to the animals. Although in other parts of the same district actinomycosis, especially of the parotid region, was extremely common, the farms on which this practice was observed remained entirely free of it.

The pharyngeal mucous membrane is probably the commonest point of entry of the actinomyces fungus, and the primary swellings almost always affect the pharyngeal walls, though infection may occasionally occur through the skin. One certainly sees cases of infection in that part of the neck which oftenest rubs against the manger. Actinomycotic abscesses of the parotid gland discharge infective pus on the



FIG. 321.—Actinomycosis of the parotid gland in an ox, from a photo by Esser.

edge of the manger, and any tiny splinters of wood present there may penetrate the skin and implant the fungi in any fresh animal placed in the same stall. This mode of infection is, however, rare. The disease varies greatly in frequency in given districts and in different years. On one farm almost every animal may be affected, whilst on another in the immediate neighbourhood the disease may be practically unknown. The reasons remain obscure, but are possibly connected with the condition in which the fodder is harvested.

The symptoms consist of a small, insensitive, sharply defined, and somewhat hard tumour, from which a cord-like thickening extends into the depths. The swelling gradually becomes larger, fluctuation appears, and if the skin is without pigment, the yellow-coloured

contents may show through. Incision liberates a thick, mucopurulent fluid, in which careful examination discovers the characteristic yellow grains. If not opened, the tumour breaks spontaneously. Cicatricial contraction very seldom brings about healing. As a rule, the growth proceeds, sooner or later producing, according to its position, functional disturbance, difficulty in swallowing, dyspnoea, and finally, in consequence of advancing exhaustion, death. The swellings in the parotid region occasionally attain a great size, sometimes becoming as large as a child's head, but such growths require several months. From the wound made by opening the abscess, grows a soft, dark-red mass of granulation tissue, which bleeds readily, and contains large quantities of the specific parasites.

Prognosis must depend on whether the new formation can be completely removed, which is seldom the case. Lasting improvement can only be expected where treatment has been commenced early, that is, before infection has become general, and treatment is more successful in disease of the skin or subcutaneous tissues than where deeper-seated structures or the pharynx or tongue are involved. Disease of the bones of the upper or lower jaw, said by Esser and others to arise from the first molars, is always very intractable. Reference should be made to the sections dealing with these structures. Cases affecting the parotid region, unless recent, are generally regarded as hopeless. Whilst Esser supports this view, Preusse has observed recovery in forty-one out of forty-five animals. It is of prime importance to remove the tumour early, before it has attained, say, the size of the hand, and while it is still circumscribed. If left longer, the growth recurs, even after careful removal. The results of treatment with potassium or mercuric iodide have proved so remarkably favourable, and been so well spoken of by different practitioners, that the prognosis of this disease must now be looked on as much more hopeful than formerly.

Treatment. Prophylaxis demands the avoidance of suspicious fodder; but this is troublesome and scarcely practicable, on account of the difficulty of recognising whether such suspicious materials are infected with actinomyces. In dealing with cattle it may be possible to steam or boil most of the food, and special care must be taken that the abscesses and their contents do not contaminate any food. Although direct infection has not been clearly proved, actinomycosis occurs in man, and veterinarians and those handling infected subjects should hence exercise due caution.

Of the various methods of treatment, operation is certainly the oldest. It consists in total extirpation of the infected connective tissue.

In operating the animal is cast, the head placed on the side, and the nose forced downwards. The operator works round the tumours, always operating in the still healthy tissue, and removes the growth as far as possible with the fingers, assisted by knife and scissors. In this way severe bleeding is avoided, and small vessels can afterwards be ligatured. For checking parenchymatous bleeding, Esser and Preusse recommend the actual cautery, which has the additional advantage of destroying at the same time any infectious material that may have remained. The wound is washed out with carbolic solution, filled with some aseptic material (salicylic wadding, Esser), and the skin sewn up. When the stitches are removed next day, the parts are washed out with a disinfectant solution, and treated as an open wound. Should the condition return, repetition of the operation is seldom of any use.

Injections of iodine tincture and 1 per 1000 sublimate solution have been recommended, but are tedious and unreliable. In some cases deeply incising the swelling and daily painting the surfaces with undiluted iodine tincture is useful. Destruction of the fibrous tissue of the growth with arsenic has been highly spoken of. Arsenic, however, can only be used advantageously in the parotid region and in cases where the growth does not extend to the larynx or pharynx. Small solid fragments of arsenious acid weighing from 3 to 7 grains are thrust into the midst of the growth in the direction of the hard cord which can be felt extending into the depth. A passage can first be made with round-pointed scissors, and the fragment of arsenic inserted with slender forceps. Another method consists in incising the skin, passing a fairly wide trocar and cannula to the base of the growth, removing the trocar, inserting the fragment of arsenic into the cannula, and thrusting it to the bottom by replacing the trocar. The entire instrument is then withdrawn. In from six to twelve weeks the diseased tissue sloughs away, leaving a wound which heals by granulation. Working oxen may be used throughout the treatment. Arsenic has also been used in the form of an ointment.

The internal use of potassium iodide has been warmly recommended. One and a half to $2\frac{1}{2}$ drachms of the salt, dissolved in water, are given daily. Under this treatment the swellings diminish, but it must often be continued for many weeks before recovery is complete. Moreover, success is not invariable, though the real value of the treatment cannot be called in question. The other methods can always be tried in case of failure.

V.—DISEASES OF THE FACE AND LOWER JAW.

THE face is here regarded as comprising that section of the head whose base is formed by the upper jaw and the malar and lachrymal bones.

(1.) FRACTURES OF BONES OF THE FACE.

On account of its sheltered position, the upper jaw is seldom fractured. In horses fracture may be due to dental operations, and in dogs to bites; less frequently to such external violence as kicks, or collision with fixed objects. During the progress of dental operations fractures result if the animal, especially when operated on standing, suddenly moves, and the operator does not follow the movement with his forceps. Incautious attempts to loosen the tooth with the forceps may also produce fracture of the maxilla. In compound fractures the broken ends or splinters of the bone are found in the wound. When the facial plate of the superior maxilla is thus affected the corresponding sinus is opened, and air passes in and out during respiration.

The symptoms consist of swelling, salivation, defective and painful mastication; the molars are found to be loose, and the gums wounded; crepitation may sometimes be detected.

Diagnosis of fractures of the malar, caused by external violence, is only difficult when much swelling exists. If not due to cellulitis, to the presence of new growths, cysts or disease of the superior maxillary sinus, such swelling should arouse suspicion of a fracture, especially if there be any considerable difficulty in mastication. Where the superior maxillary sinus is laid open, or the zygomatic ridge injured, doubt can no longer exist. Damage to the alveoli of the upper molars, or extensive tearing of muscular insertions, give rise to difficulty in feeding. Subcutaneous fractures of the malar bone, which are of rare occurrence, unite easily, and compound fractures only cause difficulty when the alveoli of teeth are exposed, and purulent alveolar periostitis results.

Prognosis depends chiefly upon whether the fracture is subcutaneous or complicated. In the former instance, recovery generally occurs in three weeks; in the latter, a much longer time is required. Complications result both from injury to the skin, and to the mucous membrane of the mouth and gums. In compound fractures with exposure of the superior maxillary sinus or alveoli of the teeth the prognosis should be cautious.

The gravity of fractures of the malar bone depends on their position. When involving the orbital process, they resemble those of the orbital process of the frontal bone and the zygomatic process of the temporal bone. When affecting other portions, they may open the superior maxillary sinus, or loosen the attachment of the masseter muscle, causing difficulty in feeding, while the fragments may become separated, and muscular contraction prevent their being replaced in position.

Treatment of subcutaneous fractures only requires restriction to soft food. Removal of loosened teeth, which may easily convert a simple fracture into a comminuted one, should be deferred. When the gum remains attached, and the root is not exposed, loose teeth again become firm. Fractures of the superior maxilla, complicated with cutaneous wounds, must be treated by antiseptic methods. If pus formation has commenced, strict cleanliness must be enforced, and loose splinters of bone removed. Complicated fractures, involving wounds of the gum, require similar precautions. Even with abundance of soft food, animals rapidly lose condition, and economical considerations often suggest that cattle be killed rather than treated. In a thoroughbred mare Möller saw transverse fracture of the superior maxilla nearly above the roots of the incisors. The fracture was caused by falling on the mouth, and all the incisors were displaced downwards and backwards towards the tongue. As the fracture had already existed for several days, replacement could not be immediately effected, but was at length attained by the attendant, according to instructions, daily exercising pressure on the dislocated teeth. Being gradually brought into normal contact with the lower incisors, the act of mastication helped to maintain them in position, and complete recovery resulted. When involving both sides, fracture of the premaxilla may result in the incisors and the bone being displaced backwards or in the bone being split and the fragments displaced laterally. In the former case a stout baton of wood can be inserted into the mouth and used as a lever to replace the bone and teeth, which then usually remain in position on account of the opposing row of teeth supporting them; in the latter case a shallow groove is formed in the corner incisor of each side and a thick silver wire passed several times around the six incisor teeth, supporting them and holding the two bones together. Compound fractures heal most rapidly under antiseptic treatment. Should purulent alveolar periostitis supervene, the affected teeth must be removed. In endeavouring to replace the fragments dislocated by the pull of the muscles of mastication, it has been recommended

first to perform myotomy. But this entails the danger of making a simple subcutaneous fracture into a compound one; while, if already compound, exfoliation of bone may ensue. Further treat-

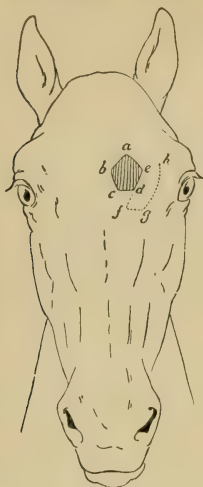


FIG. 322.

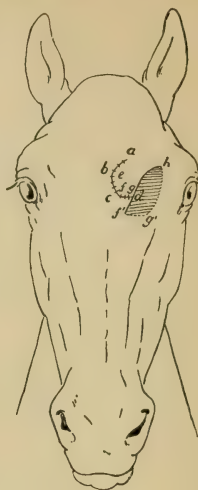


FIG. 323.

ment is regulated by general principles. Reference may be made to fractures of the frontal bone, and diseases of the superior maxillary sinus.

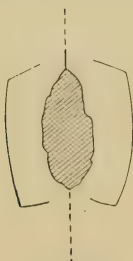


FIG. 324.

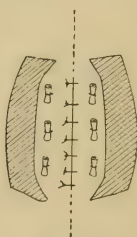


FIG. 325.

Figs 322 and 323 illustrate a plastic operation performed by Bayer to remedy loss of skin in two carriage horses which had run away and damaged the bone to such an extent as to necessitate removal of considerable portions. The skin having become adherent

to the mucous lining of the sinus, it was necessary to dissect considerable flaps in order to cover the defects. The parts were carefully shaved and disinfected, and a slender paring removed from the edges of the wound to ensure fresh surfaces for union. In the first case an incision was carried from *d* successively to points *f*, *g*, and *h*, and the flap dissected free from subjacent tissues, leaving it connected with the rest of the skin only at *a h*. The prolongation to *f* and the large size of the flap were necessitated by the knowledge that contraction would occur. The edges *a c d f* were then brought in contact with *a b c*, and *f g* were united to *c d* with closely placed sutures. Healing of the flap was perfect, and the exposed surface *h d f¹ g* soon granulated and was finally covered by skin.

When, in consequence of injuries in the neighbourhood of the neck or withers, large indolent wounds are left, healing can often be effected by incising the skin and subcutaneous tissues on either side of the wound, dissecting the skin free so as to form flaps, and uniting these in the middle line as indicated in Figs. 324 and 325.

(2.) FRACTURE OF THE LOWER JAW.

Of all the bones of the head the under jaw is the most frequent seat of fracture: this is true of all classes of animals, and notably of the horse. The causes are external violence, kicks and falls; occasionally the excessive action of the muscles of mastication, as when the mouth gag is applied to horses suffering from brain disease, or in the simultaneous application of the mouth gag and twitch. Hertwig considers that, under these circumstances, the animals are unable rightly to estimate the degree of contraction of the masseter muscles. Hering saw a case in the horse, caused by the clumsy use of the tooth chisel. In dental operations fractures may occur under the same circumstances as in the upper jaw. Transverse fracture of the body of the jaw in calves not infrequently results from violent manipulation during delivery. In a similar way fracture of the symphysis of the lower jaw may be caused by parturition hooks being inserted in the angle behind the body of the jaw. In staghounds they result from the prey striking out at the moment when the dog has fastened on to the hind limb.

The fracture is sometimes subcutaneous, and remains confined to one branch of the lower jaw; but not infrequently both branches break, and usually at the neck, where teeth are wanting. Vormeng noted breakage of both branches in the middle line, an accident which occurs more frequently in foals than in older animals. Fractures

of the border of the alveoli of the lower incisors are often seen, in consequence of the animal biting, being kicked, or falling and striking fixed objects. Fractures of the joint or coronoid process, although occasionally reported, occur less frequently.

Subcutaneous fractures of one branch of the lower jaw are not so readily diagnosed; suddenly developed difficulty in mastication is the chief symptom. In fractures in the region of the molars the teeth may continue to hold the fragments together in such a way that neither crepitation nor unusual mobility of the parts can be detected. In such cases one or more teeth may be found to be loose.

Symptoms. In transverse fractures of the body of the bone the chin and lower incisors hang limply and are abnormally mobile,

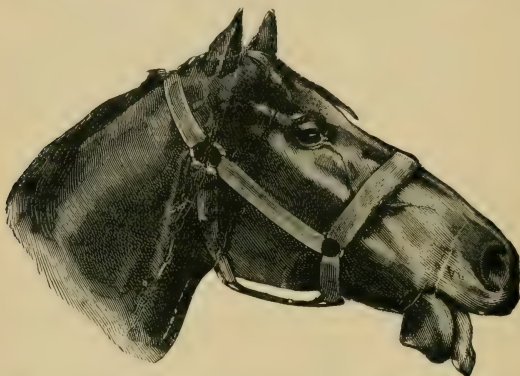


FIG. 326.—Incomplete union of fracture of the body of the lower jaw.
From a photograph.

while crepitation may be detected. Fractures of the coronoid process or joint, or in their neighbourhood, often interfere seriously with mastication, and may be mistaken for inflammation of the articulation. The broken fragments of the coronoid process are drawn upwards by the temporalis muscle, and can be detected on palpation.

Prognosis. Fractures in the median line and subcutaneous injuries of one branch unite regularly and completely in from three to five weeks. Double-sided fractures present the greatest difficulty, and often affect mastication so seriously that condition is lost in a marked degree. Transverse fractures of the body are difficult to set, and sometimes eventuate in formation of callus fibrosus, with sinking of the alveolar margin and protrusion of the tongue (Fig. 326). Grün cured the above transverse fracture in a calf by applying a

suitable splint and giving nourishment through an œsophageal cannula. The case recovered rapidly. Fractures of the articulatory process, or in its neighbourhood, are the most serious. Those of the coronoid process unite, but sometimes by the formation of a callus fibrosus. Compound fractures of the lower jaw often prove very troublesome, but are not always incurable, as recorded instances show. Nor can fractures of the articulatory process be regarded as hopeless, since Fröhner has shown that recovery may follow resection of the maxillary joint.

Treatment in simple one-sided fracture consists merely in the administration of soft food. Dislocated fragments must be brought into position. As long as the fracture remains confined to one branch no mechanical appliance is necessary; but when double-sided, con-

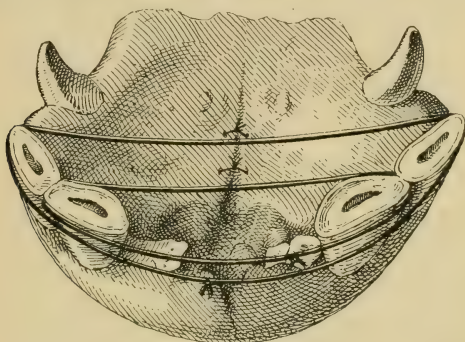


FIG. 327.—Fracture of the lower jaw united by wiring.

siderable ingenuity is required. Prince recommends a wedge-shaped splint of wood, which fits into the submaxillary space, and is fastened with straps passed over the animal's neck and head. In small patients, and in valuable large animals, a similar splint formed of gutta-percha is pressed into the space whilst soft, so as to form an exact reproduction of it; its posterior broad end is supported against the animal's throat. Another arrangement is due to Mazza. Girard arranged two bars of iron, bound together at an angle, corresponding to the direction of the posterior borders of the lower jaw, and carrying at their point of union a spoon-shaped extension for supporting the chin. The other ends were provided with rings for attachment to the halter or to a neck strap, while a strap passed over the animal's nose, about half-way up, secured the under portion of the splint in place. Instead of rods, Marrel used a gutter-like splint,

formed of tinned iron, which fitted the posterior border of the lower jaw. On the lower part were four rings for fastening to the halter and to the animal's nose and head. Fractures in the inter-dental space of the lower jaw may sometimes be reduced and fixed, by using the teeth as *points d'appui*. Thus Delamotte bored a hole between the first and second molars, and carried a wire thence around the incisor teeth. The wire having been in position for three and a half months, the fracture was found to be united. More recently bone sutures have been successfully used. As a final resort, the body of the bone may be resected without destroying the power to masticate. This has been accomplished by more than one operator, both in the case of the horse and dog. In treating fractures at the height of the first molars, Ohlsen inserted an iron splint the shape of an ordinary magnet, which was pushed into the mouth legs-foremost, and embraced the back teeth, holding both splint and bone in position: unfortunately this method is liable to loosen the teeth. After attending to diet, treatment of fractures in the neighbourhood of the articulatory process becomes expectant. Hence it is generally advisable to slaughter cattle early, rather than await an uncertain healing process. It need scarcely be added that all compound fractures must be treated on antiseptic principles.

Littlewood saw double fracture of the lower jaw in a horse, the maxilla being broken near the symphysis, and between the second and third incisor teeth. The pieces of bone were replaced during anæsthesia, a hole drilled through them, and a metal wire so inserted as to fix them in position. The operation was completely successful.

Cadiot and Dollar describe a case of double fracture of the lower jaw—viz., through the neck and through the branch under the masseter muscle—in an eight month old poodle, in consequence of a kick from a horse. A dressing formed of layers of linen smeared with pitch was applied, and further secured by bands of tarlatan passed over the head and round the neck. A muzzle was eventually applied. The patient was at first spoon-fed with liquid food and afterwards with chopped lean meat. Union was complete in one month, and the animal could take its ordinary food, though there was a slight deformity from callus formation.

(3.) DISLOCATION (LUXATION) OF THE LOWER JAW.

This occurs in carnivora: the long coronoid process and limited mobility of the joint render it impossible in herbivora unless after fracture. Drovers' dogs, staghounds, and sporting dogs most fre-

quently suffer; the first often, from being struck by the hind foot of the animal they are pursuing. Dislocation is frequently complicated with fracture. Sometimes it is confined to one side, but double-sided luxations also occur, thus resembling the condition usual in man.

Symptoms and course. The mouth hangs open, and can neither be closed voluntarily nor by external assistance. Salivation, protrusion of the tongue, and inability to eat are also present. Sometimes the ball of the eye is pushed forward by pressure of the dislocated coronoid process (exophthalmus). In one-sided dislocation the jaw hangs towards the sound side. The condition may be mistaken for paralysis of the lower jaw, and for the presence of foreign bodies in the mouth or between the teeth. But in paralysis, the lower jaw is passively movable, and the mouth can be closed by pressure, whilst the presence of foreign bodies is determined by local examination. As in rabies the mouth often hangs open very much as in luxation of the jaw, care should be observed in making the local examination. A favourable course is insured if professional assistance is sought early and no complications exist; but recurrences nevertheless occur, and animals should therefore not be used for some time after apparent recovery. Where much bleeding has taken place into the orbit, replacement of the prolapsed eye sometimes proves difficult.

Reduction is most easily effected by inserting a stick about $\frac{3}{4}$ of an inch in thickness transversely into the mouth and pushing it well back. The operator then seizes the front of both jaws and presses them together, the stick acting as a fulcrum to the two-armed lever. The coronoid process is thus drawn downwards, and can be brought into normal position by pushing the dislocated jaw sideways towards the middle line. In small animals both jaws are seized, and the dislocated coronoid process moved first downward and then backward; but care is required to avoid being bitten, and for this reason the first method deserves preference. Recurrence is prevented by giving soft food, prohibiting bones, and applying a muzzle.

(4.) INFLAMMATION OF THE ARTICULATION OF THE JAW.

This articulation, on account of its exposed position, is often wounded or injured by blows or "kicks," and purulent inflammation so caused. Cellulitis affecting neighbouring structures may extend to the joint, or it may become inflamed in horses which, in consequence of painful affections, lie continuously (decubitus). Gurlt found the

joint immobile in a goat, on account of the formation of extensive exostoses. The condition had resulted from severe bruising. Dry chronic arthritis (*arthritis chronica sicca*) of this joint is also seen in horses.

Symptoms and course. Impaired mastication is the most frequent accompaniment. The mouth cannot be properly opened, whence the condition is sometimes mistaken for trismus, from which it may be distinguished by a swelling affecting one or other, but seldom both articulations. The lower jaw is generally displaced sideways, so that the grinding surfaces of the teeth do not exactly correspond, and patients, in consequence, quickly fall off in condition, and sometimes cannot take any food at all. They often develop the shear-like mouth. Sometimes the disease ends in ankylosis of the joint.

Bösenroth saw a case of this kind in a horse, and has described the post-mortem appearance. Several similar cases occurred in Möller's practice. In a dog, which suffered from inability to open the mouth, and showed extensive atrophy of the muscles of mastication, Möller found formation of new bony material in both articulations. This had been produced by an *arthritis chronica*. Siedamgrotzky has described a similar case.

The disease is of a very grave character, especially in animals which have to consume much food, such as working-horses and milch-cows. Cases like that described by Weiss, where a horse was able to masticate regularly after displacement of the inter-articular cartilage, are exceedingly rare. An error in diagnosis may possibly have occurred in the case described.

Treatment. The patient's strength must be conserved, suitable diet provided, wounds and inflammatory processes properly treated, and the ill effects of decubitus guarded against. So long as purulent arthritis does not exist, recovery, as in Siedamgrotzky's case, may be expected. When suppuration has occurred, the parts must be washed out with sublimate solution, iodine in solution of iodide of potash, or with iodoform æther. Any fragments of bone must be removed. Re-section of the joint was successfully performed by Fröhner, but is only commendable as a last resort. Delamotte recommends injecting the cavity with carbolic or sublimate solution, and limiting the movement of the lower jaw as far as possible by means of a tightly applied nose strap. Fluid nourishment alone is indicated.

(5.) PARALYSIS OF THE MUSCLES OF MASTICATION.

PARALYSIS OF THE LOWER JAW (SO-CALLED).

A condition in animals has been described where, in consequence of diplegia of the masticatory muscles, the mouth cannot be closed. It may more correctly be termed paralysis of the muscles of mastication, or masticatory facial paralysis, as it is styled in man. According to present information, it seems almost entirely confined to dogs and cats, but Röhl, Walthrup, and Lydtin have also seen it in the horse.

Both the masseter and the temporal muscles are supplied with motor nerves from the inferior maxillary division of the fifth cranial nerve. One-sided paralysis of this nerve is much less frequent in animals than double-sided paralysis, but double-sided paralysis in cats and dogs has been repeatedly described. The condition occurs almost invariably during the progress of rabies, in fact is seldom seen unassociated with it, and therefore its presence always awakens suspicion. Although Gerlach insisted on its acceptance as a sure sign of madness, dogs and cats thus affected often recover completely, the surest proof that Gerlach's statement is incorrect. Körber and Fröhner have noticed the same thing in dogs.

The anatomical changes causing the disease are at present unknown; they are probably due to some diseased condition in the pons varolii. As a great number of nerve centres exist in this portion of the brain, it is not remarkable that this disease is frequently accompanied by other nervous disorders. In the case described by Körber, paralysis of the pharynx and muscles of the throat and breast supervened. Tempel records a case where a fibro-sarcoma extending from the guttural pouch had pressed on the facial and trigeminal nerves, paralysing them and producing the above symptoms. But that isolated cases of paralysis of these motor nerves occur, and may recover, is shown by the following illustrations:—

A grey pointer was sent to hospital, with the report that it had received an excessive quantity of beer some days previously, and had afterwards slept for a long time. When it awoke next day, its mistress remarked that its tongue was hanging out, and that it was unable to close its mouth. The animal appeared low-spirited; the under jaw hung flaccid; and when pressed into position again fell. The tongue was dry and protruding; food could not be taken, though pieces of meat placed in the mouth were swallowed with great relish. During the next few days the dog appeared quiet, somewhat apathetic, and lay continuously in a corner of his kennel. Five days later, the disease had already so far yielded to expectant treatment that the animal could again take nourishment regularly.

A similar case, which, however, appeared incurable, occurred in Möller's practice. A nine months old dog, used for drawing a barrow, showed complete paralysis of the nerve, could not withdraw the tongue, the mouth remained continually open, and in taking fluid nourishment or water, the head was thrust into the fluid as high as the eyes. The muscles of mastication, and particularly the temporal muscles, showed marked atrophy. The tongue and buccal membrane were insensitive to injuries; twitchings occurred in the muscles of the rump, like those often seen following distemper; no improvement appeared after lengthened observation and faradisation. As the owner objected to have the animal killed, a post-mortem unfortunately could not be made.

Röll and Lydtin saw cases of one-sided trigeminal paralysis in the horse. Röll states having found all three branches paralysed; the skin and mucous membrane of the affected half of the head and the cornea being insensitive. Salivation, difficulty in chewing, and accumulation of food between the cheeks and teeth existed. The mucous membrane of the nose, mouth, and conjunctiva was hyperæmic. Owing to inability to close the lids and protect the eye, corneal ulcers formed. Post-mortem discovered fatty degeneration of the roots of the nerve and meningitis at the base of the brain. Lydtin observed the disease in an old horse. Marked atrophy of the masseter and temporalis muscles of the right side had been developing for ten years, swallowing was difficult, salivation existed, the molars showed partial shear-mouth. The animal was regarded as incurable, and killed. Post-mortem showed the masseter, temporalis, and pterygoid muscles completely atrophied; their weight being only one-eighth of those of the healthy side. At the base of the petrous temporal bone, and just over Gasser's ganglion, lay a fibro-sarcoma as large as the cerebellum, which must be regarded as having caused the paralysis.

Cadéac saw trigeminal paralysis in a dog. Recovery occurred in a week. Schmidt recorded a case where a sporting dog showed sudden paralysis of the lower jaw and marked convergence of the optical axes. The animal recovered in one week.

The symptoms consist of salivation, protrusion of the tongue (which is often dry on the surface), and inability to take nourishment, to masticate, or to close the mouth completely. These symptoms, and the fact that the mouth can easily be closed by pressing on the lower jaw, distinguish this condition from dislocation of the lower jaw, or from foreign bodies lodged between the molars. Masticatory paralysis, as stated, is a constant symptom of rabies in the dog.

Prognosis must be based on general principles. Where the paralysis has only existed a short time, and is incomplete, some hope may be given. Under other circumstances, and especially where extensive atrophy and degeneration have set in, treatment is of no value. In Walther's case in the horse, and Fröhner's in the dog, improvement occurred gradually. Frick records three cases in the dog; all appeared suddenly without visible cause, and all recovered completely.

Treatment calls for appropriate nourishment, food must be placed in the mouth, and the stomach tube is sometimes serviceable. The induced or constant electric current should be tried, the poles being applied to the masseter and temporalis muscles; Fröhner states that by its daily use recovery occurs in one to two months.

(6.) PERIOSTITIS AND EXOSTOSIS ON THE POSTERIOR BORDER OF THE LOWER JAW.

Circumscribed periostitis sometimes occurs in the horse on the posterior border of the lower jaw at the height of the first molar, and induces exostosis. The most frequent cause is external violence, especially striking against narrow mangers while feeding. The periostitis seldom produces disturbance; pain is sometimes indicated by careful mastication, but the presence of exostosis usually first attracts notice. On the posterior border of the lower jaw a hard, sharply defined, round, sometimes knobby, painless swelling appears, firmly attached to the bone. Sometimes the swelling is flatter, and may then be mistaken for that produced by alveolar periostitis, in which, however, the rarefaction of bone and the swelling are on the lateral surface of the lower jaw, and mount upwards. Periostitis caused by local injury, on the other hand, remains confined to the posterior edge.

Prognosis is favourable, the mature exostosis only producing an unimportant blemish.

Treatment must conform to general principles. Prominent exostoses may be removed: a circular cut is first made through the skin and periosteum, and the chisel or saw then applied. Flat swellings are better left alone.

(7.) TUMOURS ON THE LOWER JAW.

True tumours of the lower jaw are much less common in animals than in men. Only enchondromata, carcinomata, and epitheliomata have hitherto been described, and these sparingly. Cadiot and Dollar describe a case of lobulated pavement epithelioma of the lower jaw in a horse, of which an illustration is given overleaf. "The left branch of the lower maxilla opposite the first molars appeared destroyed throughout its entire depth. In two months the tumour destroyed the central portion of the right branch of the lower maxilla, produced great disturbance, general decline, and death." Almost all the

tumours in cattle described as sarcomata are in reality caused by actinomyces. As regards true tumours the prognosis is usually unfavourable, re-section of the jaw being the only reliable treatment. It is therefore almost always best to slaughter the animal. Keiper observed an osteo-sarcoma (?) in the horse, springing from the point

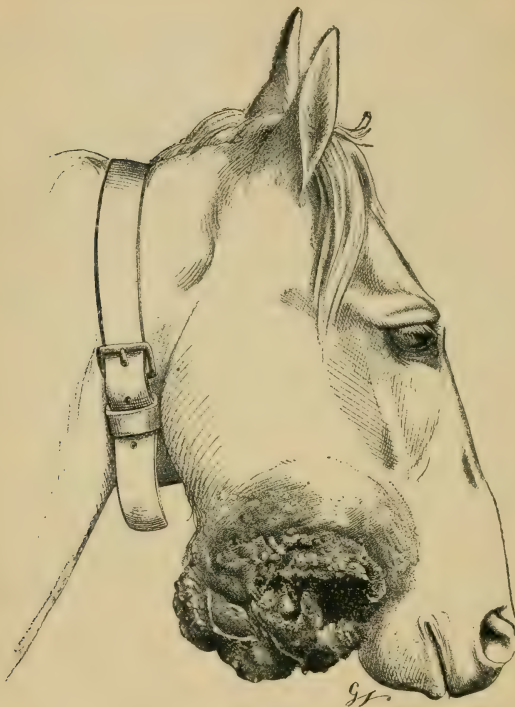


FIG. 328.—Cancer of the inferior maxilla.

of fracture of the lower jaw, between the incisors and pre-molars. This rapidly recurred after extirpation, and in twenty-two days attained a height of six and a breadth of four inches. Möller has several times removed similar growths, which have proved to be mycofibromata (botryomycomata). They usually appear on the buccal membrane, and possessing a narrow base are easily extirpated. They must not be mistaken for those new growths which arise from

the alveolus of the tooth (epulis), and are much less easy to deal with. It is important to note from what point the tumour arises and whether swelling of the submaxillary glands already exists. Tumours of

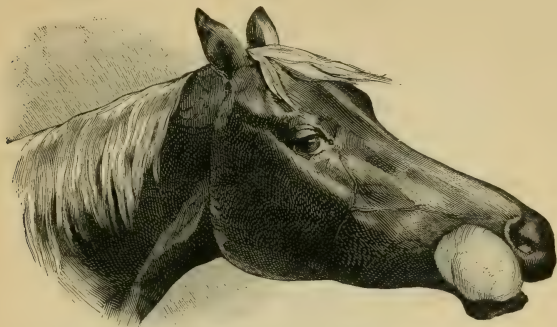


FIG. 329.—Botryomycosis of the lower jaw.

the jaw of epithelial type are probably due in most instances to paradental epithelial *débris*, thus resembling the dentigerous and dermoid cysts.

(8.) ACTINOMYCOSIS OF THE MAXILLÆ.

Actinomycosis of the maxillæ occurs in all domesticated animals, and has even been seen in elephants, though the ox is by far the most frequent sufferer. Imminger found the disease localised in the jaw in 14 out of 15 cases of actinomycosis. Marey records 541 cases; 117 of these affected the bones of the skull. The changes produced by the actinomyces resemble those due to tumour growth, and have frequently been mistaken for the latter. Vachetta describes the growths as osteosarcomata. All the older reported cases of "sarcoma" of the maxilla are probably attributable to actinomycosis.

Infection with actinomyces following injuries to the gums often causes osteomyelitis and rarefying ostitis of the jaw. This generally attacks the lower jaw, but sometimes the upper in addition, and is frequently seen in ruminants, particularly in cattle, but also in goats. The disease usually arises from one or other pre-molar. Pilz saw a tumour of this kind in a horse: it had developed in the neighbourhood of the first and second lower molars, and had four fistulous openings, from which a yellowish pus was discharged.

Symptoms. A hard, firm swelling develops on the lower jaw, which careful examination shows to be caused by an increase in the volume of the bone. The swelling spreads and increases in size; and although it is at first only slightly painful, the animal soon shows difficulty in chewing, masticating slowly, holding the head obliquely on one side, and even allowing food to fall from the mouth. Closer examination discloses the presence of purulent alveolar periostitis of one or several molars, those, namely, at the point where the swelling appears externally. The diseased teeth lie deeper in the jaw than usual, or are pressed out of line. The masticated food collected around them possesses a peculiarly penetrating and unpleasant smell, always noticed in alveolar periostitis of herbivora.



FIG. 330 —Osteoporosis of the upper jaw Esser).

The external skin increases in thickness, and gradually becomes adherent to the swelling. Later, perforation takes place, and a thick fluid yellow pus is discharged, in which actinomyces may be found. A probe penetrates deeply into the bone and easily breaks down its thin trabeculae. Granulations form around the wounds, and bleed readily when touched. As a rule, feeding is disturbed and loss of condition sets in.

Prognosis and course. The nature and position of the disease make it evident that little can be done therapeutically. The ray fungus possesses considerable powers of resistance, and when within the bone, is exceedingly difficult to reach. The disease must almost always be incurable, though Pilz and others claim to have had recoveries after giving iodide of potassium internally, and applying tincture of iodine locally. Nevertheless many unsuccessful cases have been recorded. Moussu unhesitatingly states that potassium iodide

alone is insufficient in actinomycosis of the jaw. Frick confirms this. The prognosis depends on the extent to which mastication is interfered with, and on whether the animal can still be used for any purpose. It is better to slaughter immediately the general condition begins to suffer. Post-mortem shows the bones to be perforated with granulation masses and pus cavities. The existing osteoporosis is most clearly seen after macerating the bone (Fig. 330).

Treatment, even when early adopted, offers little hope. Loose teeth must be removed, the alveoli afterwards washed out with a disinfectant fluid, and plugged with tow saturated with tincture of iodine. Where abscesses have already perforated, antiseptic injections may be tried. Tincture of iodine seems to deserve preference. The internal administration of iodide of potassium has been extensively tried in this disease, but with very varied and often negative results. Moussu's experience leads him to prefer energetic curettage of the parts and subsequent internal use of potassium iodide. But more important than these therapeutic measures is the administration of such food as makes little call on mastication, as brewers' or distillers' grains.

Pilz gave an eighteen months old foal 4 to 5 drams of iodide of potassium, and injected the swelling with tincture of iodine daily. In five weeks symptoms of poisoning occurred, appetite and condition were lost, the coat was dry and staring, the limbs swollen, and pulse accelerated, but these symptoms disappeared after the medicine had been discontinued for a fortnight. Iodide of potassium was afterwards given for periods of fourteen days at a time, until two pounds of iodide of potassium and one pound of tincture of iodine had been used. At the same time the parts were regularly washed out with different agents. Great improvement was noted; but as the foal was soon afterwards sold, the final result of the treatment could not be determined.

(9.) INFLAMMATION AND NEW GROWTHS IN THE SUBMAXILLARY LYMPH GLANDS.

Infectious processes in the lips, nose, cheeks, or nostrils usually cause swelling of the submaxillary lymph glands. This is especially noted in glanders, strangles, certain forms of cellulitis, and also in some malignant new growths, such as carcinoma, mycofibroma, and actinomycosis. In the last-named disease chronic lymphadenitis, accompanied by marked swelling, pus formation, and ulceration, may also occur.

Symptoms. The acute inflammatory diseases of the submaxillary glands are described in works on pathology. The chronic are characterised by swelling, which is slightly painful and moderately

firm, sometimes appears as a circumscribed new growth, sometimes as a diffuse enlargement of the whole gland, or of single sections of it. It develops slowly, finally breaking in several places. The nature of the disease may be recognised by microscopical examination of the discharge which frequently contains either the ray fungi of actinomycosis or colonies of botryomyces. In the horse, however, Möller repeatedly found chronic disease of these lymph glands, with ulceration of the skin and multiple abscess formation in the glands, without the presence of the above-named parasites; but in such cases pyogenic cocci were present.

Treatment requires extirpation of the gland, or of those portions affected by the new growth. Resorbent or disinfecting materials are never satisfactory. In the horse Möller frequently removed the collective submaxillary lymph glands (see Fig. 319), and he recommends proceeding as follows:—The horse should be cast, chloroformed, and laid on its back. The skin is now cut through at the point where it has become adherent to the underlying structures. The connective tissue which surrounds the gland is thus exposed, and the tumour divided from the sound structures by the fingers, aided by scissors and knife. Great care must be taken not to injure the glosso-facial artery and vein, or Stenson's duct. Wherever practicable, the operation should commence at the posterior part, in order that the blood-vessels be more conveniently ligatured. If the sublingual gland is diseased, it must also be removed. The seat of operation is then washed out, its surface sprinkled with iodoform and tannin, and, in order to check bleeding, a mass of tow or cotton wool firmly inserted before sewing up the wound. The tampon is removed after twenty-four hours, and the wound treated as an open one, when regular healing usually follows. The appearance of normal or blood-stained saliva is unimportant. The discharge ceases with the appearance of granulation.

Cysts and fistulæ of the laryngeal region are sometimes seen in the horse and dog. Thus Vachetta has seen fistulæ due to the non-closure of the branchial arches in the horse and dermoid cysts in horses and dogs. In the latter mucoid cysts, varying in size between a pigeon's egg and a man's fist, are seen in or near the submaxillary region; they usually extend downwards, sometimes behind the larynx and œsophagus. The cause of their formation is unknown; Fröhner regards them as retention cysts due to the persistence of isolated fragments of the embryonic prototype of the sublingual gland. They appear as fluctuating swellings of slow growth, unaccompanied by inflammation. Surgical treatment is difficult, inasmuch as the entire

growth can seldom be removed, and a fragment is usually left which leads to a return of the condition or to fistula formation.

The treatment of these cysts is purely surgical. Removal of the cyst is followed by recovery, but the operation is very troublesome on account of the richness of the surrounding tissues in vessels and nerves. Möller claims to have had many successes after operation. In one case, however, in a dog, the animal gradually wasted, became dull, and died without at any time showing fever.

On account of the difficulty of total extirpation Fröhner recommends injecting 2 to 5 per cent. iodine solution, which produces suppuration in the cyst. The contents are first withdrawn with a small syringe and the iodine solution injected, no antiseptic precautions being observed. Should suppuration not occur within three or four days, as can be ascertained by puncture, the iodine injection is repeated. As soon as pus is freely formed the cyst can be laid open and treated as a common abscess cavity.

Owing to failures with this method Frick now prefers to lay open the cyst fully and suture the flaps to the neighbouring skin. He then carefully mops out the cavity and thoroughly cauterises the interior with the Pacquelin cautery. The necrotic portions are shed and the cavity fills up with granulations.

VI.—DISEASES OF THE EAR AND GUTTURAL POUCHES.

(1.) WOUNDS OF THE EXTERNAL EAR.

INJURIES of the external ear are commonest in dogs, though seen in other animals. They are produced in cropping the ears and from bites. In long-eared varieties, shaking the head persistently may lead to injuries. Larger animals meet with wounds of the ears by bringing the head forcibly against nails or hooks, and occasionally by being bitten by their companions. The practice of applying a twitch to the ear, more common formerly than now, was also a frequent cause.

Cellulitis of the external ear is seldom seen in domestic animals other than the dog and pig. Pofeld saw a cow which lost a large portion of both ears from septic cellulitis. In dogs the condition usually results from excoriations of the external ear, due very frequently to otitis externa. Bites are a rare cause. On the other hand, cellulitis of the external ear is a common disease in herds of swine. Young pigs often bite each other's ears, producing a disease

which has been described as erysipelas, but is in reality an inflammation of the loose connective tissue of the outer ear and of its base.

The animals usually hold the head inclined towards the affected side. Dogs often begin to shake the head, but are soon deterred by pain and give up the attempt. The external ear is greatly swollen, in pigs of a fiery red, and shows numerous scratches and tears, from which serous fluid exudes. Handling is very painful, and the parts feel intensely inflamed. In pigs the inflammation soon extends to the inner ear and brain, as shown by somnolence, loss of appetite, and burrowing in the straw, where the animal seeks to hide itself. Pigs not infrequently die of this disease, an event of very rare occurrence in dogs.

Prognosis. The wound, when confined to the skin, is unimportant; but the cartilage being closely attached to the skin, often suffers, and may be more or less injured. In a horse Möller saw a torn wound extending from the base of the ear to its summit, and dividing it into two exactly equal portions. Transverse wounds occur, or pieces of the cartilage (recognised by its white colour) may be entirely lost. In long-eared dogs, the cartilage does not reach to the point of the ear, but is continued by a fascia-like membrane. Healing, easily effected if the parts are undisturbed, is often checked by the animal continually rubbing or shaking the ears. Longitudinal wounds heal better than transverse ones. Injuries to the point, produced by shaking the head, are difficult to heal, because the animal is prone to irritate them afresh. After a time thickening results, and ulceration of the edges of the wound occurs, laying the cartilage bare and producing exfoliation. The surfaces are usually invested with a brown crust, and bleed easily. This condition, termed "external canker," is indicative of chronic mischief, and is usually a sequel of otitis externa.

Treatment of injuries. Loose shreds, brought into apposition with sutures and treated antiseptically, will often adhere; but where appearance is not regarded, they may be removed with the scissors. After cleansing and freshening the edges with scissors, the bare and projecting margins of the cartilage are pushed back as far as possible, and pin sutures inserted on both the external and internal surfaces. It is usually sufficient to pass the pins through the skin, but it may be desirable to insert a few through the cartilage. After another thorough cleansing, the wound should be covered with gelatine and wadding, and in large animals a thin bandage passed round the ear. In dogs, the ears may be bound together on the sides of the head; whilst in horses movement can be prevented by placing the animals

on the pillar reins. If the dressing remain dry, it should be left in position for about a week. In ulceration of the cartilage, it is of first importance to prevent the head being shaken. This can be effected by bandaging the ears to the head, but preferably by the treatment recommended in inflammation of the external auditory meatus. Careful cleansing of the ulcer, followed by cauterization with the iron or strong carbolic acid, and dressing the sore with iodoform-collodion may prove successful.

Cellulitis in dogs usually subsides in a few days after the application of Goulard's extract or dilute solution of lead acetate. Scarification and disinfectant applications are of assistance in the early stages in pigs, but, if somnolence has appeared or suppuration set in, destruction of the external or even of the middle ear often follows and treatment is hopeless. For this reason fat pigs should be slaughtered at an early stage.

(2.) ŒDEMA OF THE EXTERNAL EAR. OTHÆMATOMA.

Rupture of blood-vessels, and extravasation of blood between the cartilage and skin of the external ear, is often brought about in long-eared dogs by the ears being rubbed or bitten, but more frequently from their being vigorously shaken to allay irritation arising from otitis or caused by a foreign body. As a rule, the rupture occurs under the perichondrium, and the condition, therefore, in the dog consists of sub-perichondrial blood extravasation. This usually remains fluid for a time, appears oftenest on the inner surface, less frequently on the outer, at times on both. From the position of the lesion, absorption is slow and usually incomplete.

Hoffmann, misled by the above facts, erroneously regarded the extravasate as consisting of lymph.

Symptoms. The dog holds its head on one side, and examination reveals a slightly painful, fluctuating swelling, sharply defined, rounded or longish, and varying in size from a bean to an orange. An incision liberates fluid or clotted blood, and displays the yellow white surface of the cartilage, which later becomes covered with granulations, which appear as little discrete red flecks, and gradually, during perhaps several weeks, spread over the exposed surface. Healing is tardy, and the parts generally remain thickened. Where the swelling is not opened it may persist indefinitely, and produce marked distortion.

Treatment. In slight hæmatoma, absorption may be produced by massage, though operation is usually preferable. The inner

surface of the ear is incised to the full extent of the swelling, the contents removed, and the cavity disinfected. Catgut sutures are then passed completely through the external ear so as to bind together the walls of the cavity, the knots being tied on the outer surface of the ear. To keep the edges of the wound clean, and bring about rapid healing, the wound may be painted with tincture of iodine and dusted with iodoform. Healing is further assisted by binding the ears close to the head with a broad bandage, or by using a net. This disease must be distinguished from the next in series.

(3.) INFLAMMATION OF THE EXTERNAL AUDITORY MEATUS. OTORRHOEA.

This is termed in Germany "internal canker," in contradistinction to the ulcerative and chronic inflammatory processes of the cartilage of the ear, which have been described as "external canker." To avoid mistakes, it would be better to discontinue the use of the terms *otitis externa* and *interna*.

The meatus extending from the auditory opening to the tympanic membrane has externally a cartilaginous foundation, internally a bony one. It is lined by skin, rich in wax glands.

In order to view the largest possible portion of the meatus, the head is placed downwards, the cartilage grasped with both hands, and held in such a position as to direct the passage, which lies sideways, somewhat towards the front. The aural speculum is of no great value in dogs, as the tympanum is not visible. The resistance of the animal, moreover, interferes both with the insertion of the instrument and the examination.

Causes. In dogs with long ears, occasionally in other animals, the waxy secretion decomposes in consequence of exclusion of air, restricted evaporation, and infection, and produces irritation of the lining of the meatus. Inflammation is seldom caused by the entry of foreign bodies into the external auditory opening, though Hering and others have met with acari in the canal. Although examining many dogs suffering from *otitis externa*, Möller has never found acari in the external meatus, but has seen the disease caused by *dermatocoptes cuniculi* in rabbits, and Zürn states that *dermatophagus cuniculi* produces the same result. Cadiot ascribes parasitic otitis in the dog and cat to the presence of *Chorioptes auricularum* and in the goat and rabbit to *Psoroptes communis*. Ostertag found bird-lice (*Gamasus auris*) in the external meatus of a cow: attention was drawn to the animal by its violently shaking its head. In dogs facial eczema sometimes invades the external ear, and, on the other hand, otorrhœa may produce eczema on the ear.

Symptoms. Otorrhœa may be acute or chronic, and unilateral or bilateral. The acute affection develops in the dog as a sequel to eczema of neighbouring parts, or follows infection of the meatus. The lining of the external ear is hot, red and painful. An offensive yellowish-brown secretion, usually mixed with pus, runs from the ear, and excoriates the skin below. The dog frequently shakes the head, and rubs or scratches the ear. Some patients vomit; others exhibit symptoms of nerve irritation. Proper treatment often results in recovery in eight to fourteen days.

In neglected cases chronic otorrhœa develops. It may be divided into two forms, superficial and deep. The first is commonest in dogs, and owes its origin to irritation produced by infection and decomposing secretions. Abnormal pruritus is present; the unpigmented skin of the meatus is reddened, and covered with a blackish-brown fatty material; light pressure at the base of the cartilage produces an agreeable sensation, the animal leaning towards the operator, and holding the head on one side. A bubbling sound may perhaps be heard, owing to motion of the fluid contents of the ear. After some time the secretions become yellowish-brown, and excoriated spots appear in the depths of the meatus. In the deep form one meets with a purulent discharge; granulations appear on the surface of the diseased meatus, and necrosis of the petrous temporal bone may ensue. Sometimes pus formation preponderates; sometimes the formation of granulations. The latter may obliterate the external opening. Perforation of the tympanum and otitis media are rare. Whilst irritation disappears early in the chronic superficial form, the deep form is usually accompanied by greater pain. Fröhner records vomiting in dogs, which he referred to irritation of the ramus auricularis of the vagus nerve. Implication of the middle ear or brain may produce epileptiform fits and other brain symptoms; but, considering the frequency of such ear diseases in dogs, these complications are seldom observed. Masch describes such a case in the horse, which showed a purulent discharge containing fragments of bone from the external ear. The horse was killed, and on post-mortem examination was found to be suffering from necrosis of the petrous temporal bone and an abscess under the dura mater.

Prognosis. Acute otorrhœa is readily curable, but the chronic form is often extremely obstinate. In the superficial form care and perseverance will usually succeed, but the deep form in old dogs may be incurable; the more profuse the discharge of pus, the less the chance of recovery.

The treatment of acute otorrhœa consists in repeated cleansing

of the meatus and the use of mild astringents or antiseptics. The meatus should be washed out with soap and water, then carefully dried with small pledgets of absorbent cotton, and douched with an evaporating antiseptic lotion (iodine, iodoform, or copper sulphate in ether or rectified spirit). Excoriations may be painted with a 2 per cent. solution of nitrate of silver. Where pain is excessive, a 1 per cent. solution of cocaine in glycerine, or warm oil of henbane dropped into the ear often gives relief. The evaporating lotion must be repeated at least once a day until the discharge has completely disappeared.

In chronic otorrhœa the first requisite is careful cleansing of the meatus with warm water and soap powder, followed by careful drying, and douching with a 5 per cent. lotion of equal parts of tannic and salicylic acids in spirit. Alcohol alone is of service, and 3 per cent. solution of resorcin in spirit can be strongly recommended. Butel commends a 6 per cent. solution of boric acid in alcohol. This treatment must be repeated daily, and when the disease has been neglected, and to prevent its return, must be continued for some weeks. No fluid must be left in the ears. If great pain be present, solution of cocaine, or henbane oil is useful. Bayer, after cleansing, powdered the meatus with boric acid. Resorcin, iodoform, and other materials have been recommended, but less depends on the agents used than on their careful application. Nocard recommended an ointment consisting of 10 parts of salicylic acid, 100 parts of vaseline, with a little tincture of benzoin. A piece the size of a hazel-nut is placed in the ear. Exuberant granulations are removed with a curette, or by applying a dry astringent.

Inflammation of the middle ear—that is, of the tympanum—is termed otitis media; that of the labyrinth, otitis interna; but neither is usually recognised during life. They occur from the spread of inflammation from the external meatus, the entrance of foreign bodies, or infection through the Eustachian tube. Attacks of delirium have been observed by Stadler and Schumacher in cattle, produced by acari in the middle ear (*dermanyssus avium*). Schütz and Siedamgrotzky detected tuberculosis of the middle ear in pigs. In rabbits, formation of pus in the middle ear has produced epileptiform attacks, and parasites have also been found in the meatus and middle ear, causing cerebral symptoms. The animals sometimes made rotary, sometimes rolling movements. *Manège* movements have been seen in tuberculosis of the middle ear in pigs.

Tumours are commonest in dogs, and are chiefly represented by papillomata and fibromata; the former not infrequently follow otitis

externa. They are also seen in horses. Their treatment is purely surgical, and follows general principles. Several observers have seen horns on the skin of the ear in cattle.

Paralysis of the ear in horses is usually an accompaniment of central facial paralysis. Frick has seen primary paralysis of the extensor muscles of the ear after the animal had been lifted by the ears. Rupture of the muscles can almost always be detected under such circumstances. Recovery is sometimes protracted.

Neuralgia of the external ear accompanied by epileptiform attacks has been noted in carriage horses in which the bridle straps were too short, causing the head piece to press on the base of the ear. The following case of Möller's belongs to the same category.

A horse showed powerful cramp-like movements immediately a finger was introduced into one or other ear. Passing it into the left ear, the horse at once endeavoured to bring the left hind-foot as near the ear as possible, and rapid movements were made with the muscles of the hind-foot and of the neck. Pressure on the base of the ear immediately produced these cramp-like movements. The same happened on the right side. Pressure of the bit caused similar symptoms, so that the animal was useless for work. Examination of the ears and auditory opening during life showed no change; hearing was undisturbed. Unfortunately Möller was unable to make a post-mortem.

(4.) FISTULA OF THE EAR. DENTIGEROUS CYSTS.

Fistulæ are sometimes seen in the horse at the base and near the anterior surface of the conchal cartilage, extending downwards towards the malar bone for a distance of 1 to $1\frac{1}{2}$ inches. A little serous fluid or pus discharges on pressure. On introducing a probe, at the bottom of the canal a hard body may be discovered which, if the canal be laid open, will be recognised as of the nature of a tooth (dentigerous cyst). Sometimes several small teeth are found in the cyst. Strictly speaking, the condition is not a fistula, but represents the remainder of the incompletely developed branchial arch. On this account the fistula sometimes communicates with the guttural pouch.

The phenomenon must be referred to the development of embryonic branchial arches and clefts. Sometimes the lateral plates of these visceral cavities are ruptured, and remain so, thus giving rise to fissures in the ear, pharynx, œsophagus, and neck (fistula auris et colli congenita), whilst partial persistence of the unruptured embryonic furrows produces blind sacs and dermoid cysts. The dental furrow which occurs in this portion of the embryonic apparatus results from a primitive fold of the buccal epithelium, which, as in the jaw, can produce enamel. The teeth are oftenest found in the squamous portion of the malar bone. Several—i.e., from 2 to 4—may be present; they resemble molars. Sometimes a sinus alone is present, and the tooth wanting.

Such teeth may be present (abnormally) in other positions, as the gums, the superior maxillary sinus, the testicle, and the ovary. In the malar bone they often remain unnoticed, until either acute inflammation produces swelling and prominence, or until attention is accidentally directed to the fistulous opening. They are commonest in young animals, especially during the period of dentition, and may even be seen within a few weeks after birth. The swelling is hard and firmly connected with the malar bone, over which the skin is freely movable. Sometimes cellulitis develops, followed by abscess formation, but producing no great disturbance. In horses of little value objection is accordingly raised to removal of the adventitious teeth.



FIG. 331.—Pre-auricular fistula due to presence of a dentigerous cyst.

Treatment. Where treatment is necessary the swelling is opened to the bottom, the tooth removed, the interior disinfected, and recovery usually occurs in two to four weeks. Ligature of vessels is rarely necessary. When the tooth is deeply implanted in one of the cranial bones it may be removed with forceps, but in such case there is considerable danger of meningitis, even though strict antisepsis be observed, and it may be advisable to renounce operation. The disease occurs very seldom in animals other than the horse. Verwey found a dental cyst on the petrous temporal bone of a dog, which suffered in consequence from otitis externa.

Dermoid cysts closely resemble those above described, and occur in similar situations, but usually contain a mass of deeply pigmented tissue more or less covered with hair.

(5.) CHRONIC CATARRH OF THE GUTTURAL POUCHES.

The guttural pouches, two in number, may be regarded as dilata-tions of the mucous membrane of the pharynx and Eustachian tube, with which each pouch is in free communication. The Eustachian tube is a fibro-cartilaginous canal or gutter, about four inches long, extending from the pharynx to the petrous temporal bone, where the tube is prolonged into the middle ear. The pharyngeal portion of the gutter presents inferiorly a slit-like opening leading into the guttural pouch. This orifice is protected by a fibro-cartilaginous plate or clap-valve, an expansion of the outer wall of the gutter. The pouches possess a considerable area, and are attached to the neighbouring parts by connective tissue. From their protected position they seldom suffer from inflammatory disorders; but when these do occur, they are generally of a chronic character. Exudate is retained, becomes decomposed, and irritation of the membrane continues. The fluid part escapes or is partly resorbed, while the solids, from movement within the pouches, become fashioned into chestnut-like bodies, which sometimes attain the size of a hen's egg. Their surface appears yellowish-brown, their interior yellowish, and on account of their cartilaginous consistency they have been described as **chondroids**. They are in many instances of the nature of inspissated pus. Uhlich counted 317 small chondroids weighing collectively 17 ounces. Savarese removed 240; they weighed from 5 grains up to $1\frac{1}{4}$ drams. In other cases a turbid, porridge-like fluid, containing great numbers of greyish-white grains, sometimes mixed with food materials, occupy the diseased sac. Thomassen described dropsy of the guttural pouch in a two months old foal; Johow found the pouch filled with thick mucus; the entrance to the pharynx was displaced by the swelling. The distended pouch presses on the larynx and trachea, and causes dyspnœa; thickenings or polypoid growths are often seen on the surface of the mucous membrane. Generally only one pouch is diseased, seldom both.

The **causes** include inflammatory processes extending from the mucous membrane of the pharynx through the Eustachian tube during the course of sore throat and strangles, and foreign bodies and food passing into the pouch. Whether in such cases congenital defects exist in the Eustachian tube cannot be determined from the reports of observers. Possibly defective action of the valve-like plate at the Eustachian opening may permit the entrance of food into the guttural pouch. Schlampff found 27 ounces of food in the pouch of a horse. Ruprecht records injury to the sac from

a piece of bone derived from a fractured hyoid. Hering and Hahn discovered in a glandered horse cicatrices, small abscesses and ulcers in the mucous membrane of the sac; the latter was distended with a muco-purulent collection. Hallander found a sarcoma in the guttural pouch. It had extended into the spinal canal and caused hemiplegia. The pouch showed signs of catarrh.

Symptoms. (1) The nasal discharge is one-sided, intermittent, muco-purulent, generally without unpleasant smell, occasionally appears for a time in considerable quantity, and may then entirely disappear. Pressure on the guttural pouch, as in placing the bit in position or lowering the head, increases the discharge.

(2) The swelling is sometimes slight, sometimes well marked. In one horse, whose right sac held more than 2 pounds of concretions, scarcely any swelling could be observed from the outside. In another, swelling occurred in a marked degree in the parotid region, especially when the head was lowered. Occasionally the swelling of one side is also appreciable on the other, and may give the impression that both pouches are diseased. The greater the swelling, the more marked its fluctuating character. Entrance of air into the diseased pouch causes a churning sound when the horse moves its head, and percussion reveals pretty clearly the division between fluid and air. Should the horse feed from the ground, or be ridden or driven, a portion of the contents of the sac is discharged, and the swelling visibly diminishes.

(3) Severe distension compresses the larynx, trachea, and pharynx, and produces difficulty in breathing and swallowing. Inspiration soon begins to produce a rough sound, and at a later stage expiration becomes loud. The seeming contradiction between clinical observations and Gerlach's experiments, in which filling the sac with a mass of plaster produced no difficulty in breathing, is explained by the fact that the dyspnoea is not produced by the filling of the sac, but by the distension pressing on the larynx and trachea. Filling the pouch with large quantities of fluid or gas is usually accompanied by dyspnoea, whilst filling with hard materials, such as chondroids, produces no such result. Experiment confirms this statement, which also agrees with most of the cases reported.

(4) In severe distension the animal holds the head towards the sound side—a condition particularly pronounced when the horse is ridden.

This affection is sometimes mistaken for disease of the parotid or subparotideal lymph glands, in which the swelling is, however, less sharply defined. Ulcerative processes in the pharynx and empyema of the facial sinuses produce similar discharges.

Diagnosis may be confirmed by the use of Günther's catheter. After a little practice it can even be inserted whilst the animal is standing.

Prognosis is, as a rule, unfavourable. The condition is not usually recognised until the mucous membrane of the sac has undergone considerable anatomical change, and when its walls have become concentrically thickened cure is impossible.

Appropriate treatment is sometimes followed by recovery. Although Günther describes one case, spontaneous recovery seldom occurs.

Treatment. Vapour baths, so frequently recommended, are, as Haubner has pointed out, quite worthless. Their reputation is due to error in diagnosis. Recovery is only obtained by complete removal of the contents of the pouch, and by direct treatment of its lining membrane. Entrance to the pouch may be obtained either through the Eustachian tube or by an operative wound. The first method is rarely successful, for it does not remove such solids as chondroids, nor provide sufficient exit even for fluid contents. Günther's catheter is therefore of little value in treatment though it is sometimes used for diagnostic purposes.

It consists of a brass tube about 20 inches in length; one end is closed, but is provided with two lateral openings, and is somewhat curved. The other end is also slightly bent, possesses a long opening to take the so-called index, and receives the screw of an iron handle. The index consists of a spring, about 8 inches long, and serves to fix the distance of the Eustachian tube from the entrance to the nostril. By marking with the spring the distance of the temporal canthus, which lies at an equal distance from the entrance to the nostril, one knows, on introducing the instrument, when the upper end has attained the Eustachian tube. To use the catheter the patient's head must be moderately extended. After applying the twitch and fixing the spring, the tube is passed, the bent end directed towards the palate, into the lower meatus of the nostril, until the index shows that the end of the instrument has attained the entrance of the Eustachian tube. A quarter turn is then made with the handle of the instrument, so that the point is directed to the side, and the handle of the catheter pressed towards the septum nasi, probing movements being made, until the sound passes into the guttural pouch. Unopposed progress of the instrument, without back pressure, shows that it has entered the pouch. The handle is now removed, and the contents of the sac allowed to flow through the tube. In a similar manner fluids



FIG. 332.
Günther's
catheter.

may be injected into the sac through the tube. Where the catheter is passed in an animal which has been cast, the mouth should be placed rather higher, in order to bring the bent point of the catheter

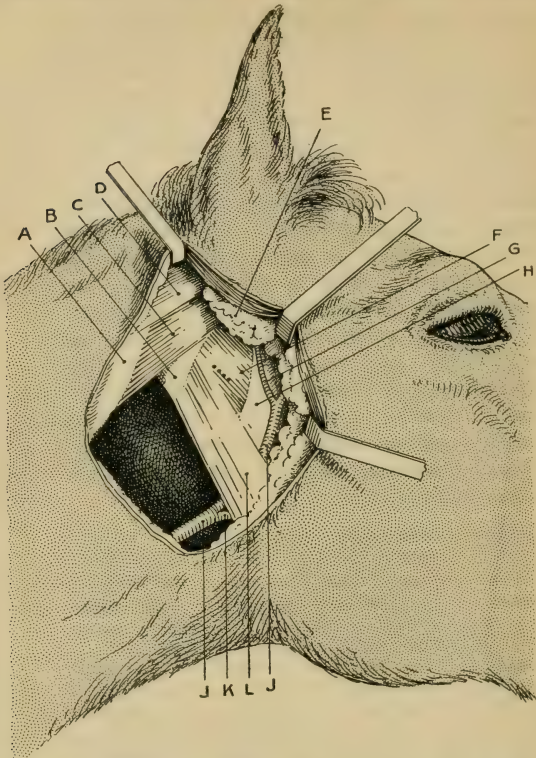


FIG. 333.—Deep tissues in the parotid region; opening the guttural pouch. (Semi-schematic.)

- A, Atlas; B, styloid process of the occipital; C, obliquus capitis superior; D, tendon of the complexus and rectus capitis posticus major (Percivall's complexus minor); E, parotid gland; F, occipito-hyoideus muscle; G, post auricular artery; H, hyoid bone; JJ, external carotid artery; K, submaxillary artery; L, digastricus; the stylo-maxillaris forms the posterior portion of this muscular mass. The dotted line indicates the point where the occipito-hyoideus is usually punctured.

sideways into the Eustachian tube, by moving the handle towards the septum nasi.

For opening the guttural pouch various operations have been recommended, all of which have their advantages and their draw-

backs. Although the pouch has been opened in the standing position, most operators prefer to have the horse chloroformed and placed on the side, with the head and neck slightly raised. Where excessive dyspnœa exists, it may, however, be aggravated by casting, and Leblanc and others recommend that tracheotomy should first be performed; but this seems undesirable, and it suffices if the instruments for tracheotomy are at hand.

Chabert, in 1779, propounded the oldest method, viz., **Hyovertebrotomy**, by which the pouch is penetrated through the occipito-hyoideus muscle. The hair in front of the wing of the atlas for an area of 2 to 4 inches is shaved; an incision is made through the skin about $\frac{3}{8}$ of an inch in front of the anterior border of the wing, and parallel with it. Just in front of the wing lies the auricular nerve, arising from the second cervical nerve, which must be avoided.

Separating the subcutis by a few light strokes, the parotid gland appears, and is laid forward. The fascia of one of the muscles of the neck, now in view, is divided in the direction and to the extent of the skin incision. The occipito-hyoideus muscle thus exposed is pierced with the finger, or a pointed bistoury, the back of the knife being turned towards the wing of the atlas, and the handle a little inclined towards it. In this way the point of the knife enters the angle made by the 9th and 10th cerebral nerves with the internal carotid, and without injuring these. Through this opening the finger can be inserted into the guttural pouch. This operation has the disadvantage of endangering the nerves and vessels mentioned, nor is the opening into the sac sufficient for the removal of such solid contents as chondroids.

Viborg recommended opening the sac below from the triangle which is formed by the tendon of the sterno-maxillaris muscle and the submaxillary vein, with the vertical border of the lower jaw. In the middle of this triangle, and parallel with the muscle named, an incision is made in the skin, about 2 to 4 inches in length, and reaching to the border of the lower jaw. After separating the panniculus of the neck, and dividing the connective tissue, the guttural pouch is perforated with a trocar, and the opening can then be enlarged with the fingers. This method has the advantage of opening the pouch at its deepest point, thus more easily removing both fluids and solids. The pouch, when distended, is easily reached by this method, which, however, is not always free from difficulty. As has been shown by Hering, some cases of supposed hyovertebrotomy have only been the evacuation of a parotid abscess.

The following method, which consists in opening successively the superior and inferior parts of the guttural pouch, is probably the best. It is at first like Chabert's, but the cutaneous incision is carried a little further, extending over the lower edge of the wing of the atlas. The cutaneous incision having been made, the hinder edge of the parotid gland is gently raised and pushed forward, and between the long horn of the hyoid bone in front, and the styloid process of the occipital behind, the subparotidean fascia is cut through, bringing into view the occipito-hyoideus and digastricus muscles. The two fore-fingers dilacerate the connective tissue, and the angular space (occupied by the occipito-hyoideus) between the styloid of the occipital and the hyoid cornu is discovered. At the centre of this space, a straight bistoury, with its cutting edge turned towards the hyoid bone, is passed obliquely downwards and forwards through the muscle into the guttural pouch. The knife having just penetrated the pouch, is withdrawn, and the puncture is then enlarged by a sharp thrust of the index finger. If the knife is directed towards the ear or atlas, it may wound the facial nerve, posterior auricular artery, internal carotid, or the nerves that accompany it; if towards the larynx, the hypoglossal nerve and external carotid artery will be endangered. Deep puncture is also dangerous, for if the knife is implanted perpendicularly it may reach the internal carotid artery, vagus and accessory spinal nerves.

Counter opening. To pass a gauze or rubber drain through the guttural pouch, a counter opening must be made and preferably in Viborg's triangle. For this purpose Dieterich employed a curved trocar; but the operation may be more easily managed with an S-shaped probe, or a blunt seton needle passed through the upper wound into the pouch and directed towards Viborg's triangle, the counter opening being made over the point of the probe. The rubber, tape, or gauze drain is then drawn into position, and the ends are tied together over the parotid gland.

The further treatment consists in flushing the pouch with disinfectants and astringents, after removing the contents. Too much fluid should be avoided, as it may enter the pharynx, trachea, or lungs by way of the Eustachian opening. Degive lost a horse in this way from a solution of potash entering the lungs and producing pneumonia.

The method just described no doubt deserves preference; it lessens the danger of injuring large vessels or nerves, and insures complete evacuation of the pouch. Following Dieterich's directions, Möller succeeded in passing his hand into the guttural pouch, and examining from this point the Eustachian tube.

An aged grey working-mare was sent into hospital on account of swollen throat. The head was held extended, and side movements avoided. A thick yellowish-white frothy fluid ran from the nose, and was increased and became purulent on depression of the head. A snoring inspiratory sound could be heard when the horse was resting, which, on the slightest excitement or movement, became audible also in expiration. Deglutition caused difficulty; part of the water taken returned through the nostrils. A swelling existed in the parotid region, most marked on the right side, where it was pear-shaped, the smaller end lying at the base of the ear, the lower border overpassing the anterior edge of the neck by about 2 inches, and extending over the trachea. The swelling was 14 inches long and $11\frac{1}{2}$ inches broad at its greatest breadth. On the left side it presented a rounder form, was of less size and less sharply defined. Its length was $4\frac{3}{4}$ inches and greatest breadth 6 inches. The skin on both sides of the neck showed traces of the application of irritants. Distinct fluctuation could be detected, percussion produced in the lower sections of the right side a hollow note, which was distinctly tympanitic in the upper part. The percussion sound on the left side was everywhere resonant. Movement of the head and pressure on the swelling produced on both sides a distinct splashing sound. The cicatrix of a tracheotomy wound was visible in the middle of the neck. The larynx seemed to have retained its normal position, though the trachea was bent at a point below the swelling. No doubt could exist as to the diagnosis, and operation was decided on by Dieterich's method, with the modification that the incision was made with a seton needle. The great swelling and displacement of the organs rendered it impossible to discover the point of division of the arteries. Immediately on incision a quantity of unpleasantly smelling gas was discharged. After making an opening in Viborg's triangle, about five pints of turbid fluid, containing white lumps, flowed out. The cavity was washed, and a thick drainage-tube inserted. When the horse got up, the swelling had disappeared on both sides, the breathing was regular, and food could be taken without difficulty. From the second day following operation the guttural pouch was washed out once daily, with either 3 per cent. solution of tannic acid or 1 per cent. permanganate of potash. The running from the nose decreased greatly, though a muco-purulent discharge continued to flow from the lower operation wound. The condition now remained at a standstill for a long time, and a lotion of acetate of aluminum was used for rinsing the guttural pouch. The wound closed after removal of the drainage-tube, but had to be re-opened because the sac had again filled. Washings with permanganate, acetate of aluminum and 1 per thousand of corrosive sublimate were without success. The discharge continued, though in smaller quantities. On June 9th, 88 days after the first operation, the patient was cast, and the operation wound so enlarged that the hand could be passed into the pouch and the fingers introduced into the Eustachian tube. The finger of the left hand, introduced from the mouth, could also be passed into the Eustachian tube, so that both hands met here. The tube appeared widely dilated; but it was further laid open with a guarded tenotome, in accordance with Bassi and Niebuhr's suggestions. The sac continued to be washed out, and from time to time painted throughout with a 1 per 1000 solution of sublimate. But this treatment remained unsuccessful. No marked contraction occurred in the mucous membrane, and the pouch preserved its abnormal size. When it was seen on June

17th that the horse showed no dyspnœa, even on movement, treatment was discontinued, and the animal sent to grass. In December the horse was quite capable of work; the operative wound was not then closed, though it had become smoothed off. The discharge was slight, and the pouch markedly smaller.

This case shows how obstinate the disease may be. Such difficulties are to be expected. Where the condition has existed for a long time, and the sac has been much dilated, it cannot, owing to its connection with neighbouring parts, readily resume its normal volume. Possibly dilatation of the opening of the Eustachian tube produced by the discharge also forms an obstacle to healing.

Thomassen's case of hydrops of the pouch also showed swelling, slight respiratory dyspnœa, and want of appetite. An experimental opening was made, and four pints of amber-coloured serum allowed to escape. A drainage-tube was inserted, and recovery occurred in three months.

Cadiot and Dollar describe a case of chronic pharyngitis and catarrh of the guttural pouches cured by double hyovertebroto-my. The animal was thin, had difficulty in swallowing, showed a mucopurulent discharge mixed with fragments of food from both nostrils, and occasionally suffered from violent attacks of coughing. Part of the drinking water returned by the nostrils. Both guttural pouches were opened and daily irrigated with antiseptic solutions for a period of three weeks. Recovery was almost complete in a month. ("Clinical Veterinary Medicine and Surgery.")

(6.) TYMPANITES OF THE GUTTURAL POUCH.

The significance of the guttural pouches has been variously interpreted. Franck viewed them as safety valves to control the air pressure in the middle ear, and prevent excessive tension of the tympanum by alteration of pressure. The suggestion that they are involved in voice production, or that the respiratory air is warmed during its stay in them, seems improbable.

Perosino discovered, by experiment, that during expiration the pouches were dilated, and that during inspiration they collapsed again. He introduced a tube containing alcohol into the pouch through a cannula, and noticed that the fluid rose during expiration and fell during inspiration. The phenomenon was exaggerated during violent respiration. Perosino therefore considered the guttural pouches were intended to moderate the stream of inspiratory air during violent exertion. Prince, on the other hand, supported the view first suggested by Prange, viz., that the guttural pouches serve to assist movements of the head by acting as elastic cushions. Perosino states that, in animals suffocated by stopping up the nostrils, the guttural pouches are enormously dilated.

The disease described by French authors, and especially by Vatel and Gohier, as guttural tympanites, has been observed repeatedly by others. Friebl and Kühnert found this condition in foals soon after birth. It consists in the accumulation of abnormal quantities of air or gas in the guttural pouches, which become so dilated as to cause severe dyspnoea. A swelling appears in the region of the parotid which is resonant on percussion, and on strong pressure sometimes produces a whistling sound in consequence of air escaping from the Eustachian tube. It occasionally occurs in foals, and affects both guttural pouches. If the sacs are opened the gas escapes, but reaccumulates as soon as the openings close. Reported cases show that tympany may be due to one of two causes.

(1) Atmospheric air enters through the Eustachian tubes and gradually accumulates in the guttural pouches. This probably occurs during deglutition, and is caused by some defect of the clap-valve which guards the opening into the pouch, the valve allowing air to enter but preventing its exit. Even in normal subjects, exit of air appears to be difficult. Degive injected air through a cannula into the guttural pouch of a dead animal, and noticed that it was retained for a long time. Gerlach referred the condition to paralysis of the elevators of the soft palate, which he considered should close the Eustachian tube, because in one of his cases these muscles seemed atrophied on the diseased side. K. Günther also considered that the pouch might become distended in this way. The air which has so entered, according to Gerlach, is unable to return, because the tube closes like a valve at its point of entry into the guttural pouch. Investigations in the horse, carried out with the pharyngeal speculum, do not, however, support this idea.

(2) Other published observations ascribe the condition to the development of gas during catarrhal disease of the guttural pouch (Bassi, Degive, Möller).

Treatment. Cases associated with disease of the mucous membrane and the accumulation of fluid secretion are treated according to the principles previously described. Where atmospheric air accumulates, Günther's catheter is used; and if the condition recurs, the guttural pouch is opened, and a drainage-tube inserted. Stockfleth employed this method successfully. Friebl pierced the cavity with a trocar, and injected astringents like 2 per cent. solution of sulphate of zinc. Where such methods are unsuccessful, it is better to divide the opening of the Eustachian tube, as was done by Niebuhr with good results. Possibly the valve-like action of the tube is thus done away with.

McFadyean failed to effect a cure even after several times operating. On post-mortem examination of the case he found the opening of the Eustachian tube contracted and indurated. In one case Degive succeeded in effecting recovery by making a large opening into the pouch and injecting it daily with a solution of silver nitrate (1 to 200). Thomassen recommends opening the sac at the posterior border of the under jaw, dilating the opening with the forefinger, and washing out with some antiseptic fluid. On account of the dyspnœa often present, the same principles obtain as in treatment of catarrhal affections of the guttural pouch.

VII.—DISEASES OF THE SKULL.

(1.) FRACTURES AND INJURIES TO THE CRANIAL BONES.

THE cranial cavity is formed by the parietal, interparietal, temporal, occipital, and sphenoid bones, in front by the ethmoid and the upper section of the frontal. Fractures of the cranial bones are caused by falls (either forwards or backwards), collisions, kicks, horn thrusts, and in carnivora by bites from other animals, kicks, and similar injuries. The sphenoid is sometimes broken by the *contrecoup* resulting from collisions. Subcutaneous fractures of the above-named bones occur, but complicated fractures are most common. In some cases concussion exists simultaneously with injury of the brain or spinal cord produced by dislocated fragments of bone.

König has given a *résumé* of the frequency with which the cranial bones are respectively fractured, based on the official statistics of the Prussian army. Of 2,984 cases of cranial fracture, 55 affected the occipital bone, 40 the sphenoid, 33 the frontal, 10 the parietal, 4 the temporal, and 2 the ethmoid.

The **symptoms** of cranial fracture are, in the absence of displacement, often very ill-defined. Local swelling and pain are often absent, even slight depressions in the skull often escape observation, and do not always produce cerebral disturbance. Should the dislocation be considerable, marked interference with consciousness, equilibrium, respiration, and circulation may result. The animal shows spasmodic seizures, and is unable to stand.

Prognosis is uncertain. Where the fracture is complete and displacement has occurred the condition is exceedingly grave. Recovery may occur, however, even in such cases. Uebelen saw a dog and Meyer a cow recover, in both of which the brain was exposed

and injured. Whitlamsmith saw a dog in which the brain protruded in consequence of injury with a knife. A piece as large as a bean was removed. For two weeks the dog showed paralysis of the right side and *manège* movements; then gradual recovery began and finally became complete. Möller has often seen injuries in horses and dogs successfully treated where both skull and brain were injured. In a dog deafness remained, and its behaviour suggested that sensation was also defective. Some years later death resulted, and post-mortem showed a well-marked injury to the temporal bone and to the subjacent portions of the brain. Where the wounds become infected the animals usually die of purulent meningitis. In horses Möller has repeatedly treated injuries of the parietal bone caused by animals running against sharp objects. In one the dura mater was exposed. As the patients came for treatment soon after injury, and antisepsis was carefully carried out, healing was effected by primary intention in from three to four weeks, without either constitutional disturbance or formation of pus. It is often impossible to discover the extent of the injuries produced by the fracture. Prognosis must accordingly be guarded, notably when brain symptoms accompany the injury, and especially when these have existed for several days, or have appeared after the lapse of some time. A favourable termination is to be expected when no brain symptoms like dulness, irritability, spasms, &c., appear during the first eight days after injury. Until this lapse of time prognosis must always remain doubtful.

Gröning observed fracture of the left parietal in a horse through falling over backwards. Some days later slight improvement set in, but, though feeding was not interrupted, periodical excitement and fright were present. On the sixth day epileptiform attacks occurred, and death followed on the seventh. Post-mortem showed a small extravasation of blood in the cranial cavity, 3 drams of a clear light-red fluid in the ventricle, and a linear fracture of $2\frac{3}{4}$ inches in length in the left parietal bone. Conti saw fracture of the skull produced by casting. The animal remained unconscious for a short time, and then struck out violently with the feet. It died on the fourth day, and a post-mortem showed three lines of fracture starting from the occipital bone. One ran from the left condyle to the foramen lacerum basis cranii; the second reached to the base of the right condyle; whilst the third divided the occipital from the temporal bone. The bodies of the occipital and sphenoid bones were further fractured in several places. Pflug saw fracture of the skull in the horse caused by falling over backwards. The animal died on the spot. Post-mortem showed the cranium to be completely divided in a transverse direction into two parts. The medulla was torn away from the brain.

Franco Gonelli describes a case of fracture of the base of the skull in a horse brought about by falling into a trench; the horse's mouth struck

on the edge. The animal was able to travel more than two miles after the accident, but then showed signs of coma, the temperature fell to 97·6° F., and the heart's action to twenty-four beats per minute. The respiration was irregular. After some hours the horse died. Post-mortem examination showed the entire base of the skull to be fractured. Extra-meningeal bleeding had occurred and extended as far as the entrance to the spinal canal.

Fractures of the sphenoid and of the occipital, and even of the other bones of the skull, usually produce death in a short time, often after a few seconds. Fractures of other cranial bones may prove fatal if attended with much bleeding into the brain cavity. Mariot saw a horse, after falling, die with loss of consciousness and advancing dyspnoea. Becker records that a horse, after having struck its head against a wall, immediately died. Post-mortem showed a comminuted fracture of the occipital, with severe extravasation of blood on the medulla oblongata.

Treatment. In subcutaneous fractures, without much dislocation, rest alone is required. Cold applications, laxatives, and spare diet tend to ward off brain symptoms, and may suffice in small fractures where dislocation of the fragments is only slight, and the brain functions are not disturbed. Replacement should be attempted where it can be effected without making a wound, and thus endangering aseptic healing. Strict antisepsis must be adopted in compound or complicated fractures where the injury is still recent, *i.e.*, has not existed for more than twenty-four hours. The hair is cut or shaved, the wound examined with a disinfected finger, splinters of bone and foreign bodies as far as possible removed, and the entire surface carefully washed out. Plenty of disinfecting fluid must be used, preferably in the form of a strong stream. No harm is done if the fluid penetrates the connective tissue and produces oedema. Loose shreds of tissue are removed with the scissors, the wound sutured with sterilised material (catgut or silk), and a dressing applied, kept in place in the horse with the help of the head collar, to which the turns of the bandage are fastened. The horse should then be placed on the pillar reins, so that it cannot rub off the bandage, as it frequently attempts to do. During the first forty-eight hours the patient must be watched, and the usual measures taken to ward off brain symptoms.

(2.) CONCUSSION OF THE BRAIN (COMMOTIO CEREBRI).

Concussion is induced in horses by falls or collisions, and less frequently by kicks from a shod foot. Wilhelm diagnosed the condition in a cow which had fallen a distance of 14 feet off a wall. Dogs and cats suffer from falls from windows as well as from blows on the skull.

The symptoms consist of loss of consciousness, inability to stand and walk, sometimes pallor of the mucous membranes, and a small, infrequent pulse. In carnivora vomiting may be present. Respiration is sometimes irregular. Various views are held concerning the alterations produced in the brain: molecular displacement is scarcely sufficient explanation, nor do the experiments of Koch and Filehne demonstrate the precise pathological conditions.

Course. Where concussion is not associated with fracture of the skull, bleeding into the cranial cavity, or further injuries, the symptoms usually disappear in a short time, often after a few hours, at latest after some days. A so-called reaction sometimes follows, the mucous membranes become red, the pulse more frequent and wiry—conditions indicating febrile mischief.

Medical interference is usually contra-indicated, and if adopted must be confined to treating symptoms. The drugs oftenest employed are heart stimulants.

Absolute rest and easily digestible food in moderate quantity are desirable. In a case reported by Wilhelm, complete recovery occurred after two days.

(3.) FRACTURES OF THE FRONTAL BONE.

When occurring in the upper portion, **prognosis** and **treatment** are the same as in fractures of the skull. It is otherwise where the wall of the frontal sinus or the external plate of the bone is alone involved. Fractures here have a different signification according to their position. In most cases the prognosis is favourable and treatment successful, as experience in trephining the frontal sinus would indicate. In ruminants, fracture of the frontal bone only becomes serious when the inner plate of bone is affected; then treatment is similar to that in fractures of the skull. Fracture of the horn core will be considered later. In those of the orbital process of the temporal bone the eye may be endangered, as in fracture of the orbital process of the malar bone, either on account of dislocated

fragments or extravasated blood pressing on the eye and producing exophthalmos. Swelling of the orbit may, moreover, extend to the optic nerve, and through its atrophy produce blindness. Sometimes the lower jaw is also endangered.

The guides to **diagnosis** are the displacement of the fractured process, the position and extent of the swelling, and the appearance

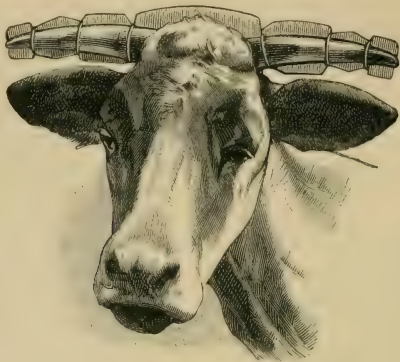


FIG. 334.—Splint for fracture of horn core.

of the connective tissue of the eye, but where there is much swelling diagnosis may be doubtful.

Treatment. Subcutaneous fractures of the orbital process, without marked dislocation, only require cold applications to minimise bleeding, and consequent danger to the eye. The animal should receive no food during the first twenty-four hours, for



FIG. 335.—Form of above splint.

masticatory movements are not only painful but produce bleeding. Complete resection of the orbital process is not difficult, and in cases of compound fracture may become necessary. Any considerable displacement should be rectified, if needful, with the help of the bone elevator. Hendrickx recommends trephining. Antiseptic measures must be adopted from the outset, non-irritant fluids being selected. A bandage is then applied.

Fractures of the **horn core** are not uncommon in ruminants.

They are recognised by the animal's resistance to manipulation of the parts, by abnormal mobility of the horn, and swelling, or even crepitation. Where blood has entered the frontal sinus there is often blood-stained or (in cases of longer standing) purulent discharge from the nose; in empyema of the frontal sinus the head is often held lower on the affected side.

The course is generally favourable; union goes on regularly in subcutaneous and often in complicated cases, especially if antiseptic treatment is early applied. In neglected and bad cases it is often advisable to remove the horn core entirely. In cows grave consequences are sometimes observed. Textor describes the occurrence of epileptiform seizures, which, however, disappeared when the sanguineo-purulent contents of the frontal sinus had been removed. After such fracture, a bull was unable to cover cows; erections occurred, but the animal, when attempting to spring, fell towards the diseased side, and was useless for stud purposes. In compound fractures pus formation may involve the brain, and bring about death from meningitis.

Treatment in subcutaneous fractures requires fixation of the horn core, which may be effected by a suitable splint passed over both horns, and secured by bandages (Fig. 335). Skin injuries must be previously disinfected. The animal is tied up so that the horn cannot be displaced. When the horn is but slightly loosened it is often sufficient to pass a bandage in a figure of eight tightly round both horns. Oblique fractures are often sufficiently kept in place by the horn itself, and the application of a tar bandage is quite sufficient. Where the core is so completely separated that union is not probable, it should be removed with the saw, and a dressing applied.

Fractures of those portions of the bone which cover the brain are often attended with injury to the mucous membrane of the frontal sinus, and are indicated by swelling, depression on the forehead, a nasal discharge, at first blood-stained, and later purulent. These fractures, although usually healing without disturbance, are sometimes followed by chronic purulent disease of the frontal sinus. When the fracture remains subcutaneous, and no blood is discharged from the nose, recovery occurs without trouble.

Compound fractures are treated antiseptically; any cutaneous injury requires complete asepsis; where the mucous membrane of the frontal sinus is injured, as indicated by blood-stained discharge, complete asepsis is more difficult. But even here healing may be effected, and often before this is complete the animals may be

returned to work. Severe dislocation inwardly may be remedied by the use of the bone elevator, or by trephining. Other symptoms are treated according to general principles.

(4.) LOOSENING OF THE HORNS.

Loss of one or both horns occurs under similar circumstances to fracture of the horn core. Sometimes the connection between horn and horn core is only loosened, or the sheath is fissured. Sometimes the horn, although completely divided from the core, can be replaced, but the new horn never attains the natural form, and a blemish results. Loss of the horn is accompanied by profuse bleeding, but otherwise scarcely exercises any other visibly injurious effect. Where the horn is loosened, its exterior is thoroughly cleansed, dressed with an antiseptic and protected with a bandage smeared with tar. If completely loosened, the horn is removed, and similar treatment is applied to the horn core.

Fissure of the horn sheath arises from blows or bruises caused by attendants or other animals, or it may be self-inflicted. The fissure resembles sandcrack of the horse's hoof. It may be superficial or deep, bleeding, or suppurating, sometimes involving the covering of the core or even the bony process. Treatment is directed to arresting bleeding and suppuration, by applying antiseptic astringents. A solution of gelatine (5 per cent.) forms an excellent hæmostatic; and iodoform-tannin is very useful as a dressing in simple cases of horn fissure.

(5.) WOUNDS AND INJURIES TO THE SKULL.

Wounds and injuries, unaccompanied by fracture, require no special treatment. Concussion may be produced by severe shocks, and is recognised by deafness, uncontrollable movements, and staggering. During phrenitis, horses sometimes injure the head, and it may be difficult to determine whether the brain affection or the injury stands first in order. In the horse, the skin carrying the forelock is sometimes extensively torn by sudden awkward movements of the head against fixed objects, and union is often difficult. Where primary union cannot be effected, the divided flap contracts, causing a blemish and depreciation of value. The injury is very common in pit ponies which work in low seams and without some special protective cap. In such cases the flap may

be entirely removed, as appearances are of little importance, and such animals are not troubled by flies. Where a fragment of the occipital crest has been detached it should be removed, whether the wound be recent or of old standing. Healing is usually easy.

In the dog pus formation in the temporal muscles is often kept up by foreign bodies. From a hunting-dog Möller removed a splinter of wood $3\frac{1}{4}$ inches long, said to have been in position for nine months. It had caused recurring abscess formation. The wounds in cattle resulting from pressure of the yoke will be described under the head of pressure injuries.

Prognosis and treatment are simple. Attention must be given to concussion of the brain, which is sometimes present. Rest and antiphlogistic laxative treatment are indicated. After careful disinfection, the edges of the wound are brought together with button sutures, or by other sutures placed at some distance from the margins, and a bandage applied. When pus formation has set in, retraction of the lappets may sometimes be prevented by inserting deep stitches with a thick thread. Where pus formation is seen in the temporal muscles of dogs, examination of the face should be made, to insure the removal of such foreign bodies as shots or splinters of wood.

(6.) YOKE-INJURIES IN WORKING OXEN.

In working oxen the yoke often injures the head, necessitating skilled treatment. The causes of such injuries are very varied. Sometimes the skin alone, especially at the base of the horns, is bruised. Extravasation of blood under the skin is rare, though excoriations and even superficial necrosis of the skin occur frequently. Periostitis in the yoke bed is probably more common than is thought, but escapes observation. So long as the injury remains aseptic no great harm results, but when the parts become infected serious symptoms may follow. Extensive bruising of the skin with excoriation and free suppuration is rare, but furunculosis on the other hand is fairly common. Deep-seated suppuration, with necrosis of the periosteum and bone, and disease of the frontal sinuses, occur in exceptional cases. Suppuration near the base of the horns is of particular importance, as the horns may thus be lost, seriously impairing the animal's usefulness.

The causes of these yoke-injuries are partly of a constitutional character. A narrow forehead concentrates the pressure on one spot, a bulging one causes the yoke to rock. Failure to keep the

parts clean where the yoke rests predisposes to injury, especially in wet weather. Badly-fitting yokes are a fruitful cause of bruises and excoriations; but want of skill in padding the yoke is less serious than unskilful padding in the case of horse collars.

Symptoms. So long as the injuries are of an aseptic character the animal only shows a certain unwillingness to pull. This is often attributed to temper, and the veterinary surgeon is therefore rarely called in, his services being first invoked when there is some visible wound. Injuries are most liable to occur when the horns grow in a forward and downward direction.

The prognosis is usually favourable; even extensive bruising of the frontal bone heals under suitable treatment. Injuries at the base of the horns must always be regarded with suspicion, as they may lead to loss or displacement of the horn so that the yoke can no longer be applied.

Treatment is chiefly of a prophylactic character. The yoke should fit well and its bed should be frequently cleaned. Oxen working together should be of similar speed and temperament, and the driver should see that each does an equal share of work. The local injuries are treated on general principle. In cases of necrosis, separation of the periosteum or horns from underlying tissues or abscess formation, free use of the knife is called for. Every effort must be made to preserve the horns and to ensure the resulting cicatrix being as small as possible. If it is imperative that the animals continue at work, circumscribed injuries may be shielded by surrounding them with pads and so relieving them of pressure. Extensive disease of the yoke bed necessitates either entire rest or the use of a collar.

(7.) TREPHINING THE CRANIAL CAVITY IN SHEEP OR CATTLE, OR OPENING BY THE TROCAR.

The cystic form (*Cœnurus cerebralis*) of the tape-worm of the dog (*Tænia cœnurus*) often develops within the cranial cavity of the sheep, and occasionally in that of cattle and other animals. It usually attains the size of a hen's egg, and animals may die from the resulting disturbance. So-called gid or sturdy generally appears in the first or second year of the sheep's life, producing significant phenomena. No treatment short of operation is effectual. Cauterisation, or refrigeration of the skull with ice, even when persisted with for three weeks, is of no avail. Opening the skull with a trocar or borer, or by trephining in suitable cases, is the only

satisfactory treatment. Even in the previous century this was attempted by laymen in a primitive way with the pocket-knife, but success could only be satisfactorily attained when proper instruments had been constructed. These consist of a small trephine about $\frac{3}{8}$ of an inch in breadth, or of special trocars, which have been perfected by Zehden.

It is of primary importance to fix the position of the cyst (or cysts). This is usually in the neighbourhood of the surface of one hemisphere of the brain. Sometimes it can be recognised by the softness and yielding of the bone on strong pressure. Percussion gives a dull sound over the affected spot, a symptom to which Villborg directed attention last century. But these signs are often entirely wanting, and the position of the parasite can only be conjectured from noting the peculiarities of the patient's movements.

(1) Where the patient shows turning movements, with the head inclined to one side, the cyst generally lies on the surface of one hemisphere, and on the side towards which the animal turns. Though this symptom, according to Möller's experience, is by far the most reliable, exceptions occur, especially where the cyst is large, and presses on the deeper-lying portions of the brain.

(2) Twisting of the head towards the hind-quarters points to the cyst lying in the depth of the hemisphere of the same side, or in the base of the opposite ventricle.

(3) A depressed position of the head, with a desire to make trotting movements, and abnormal raising of the fore-limbs, suggests that the site is towards the front of the hemisphere, or in the depths of the hemisphere towards the corpus striatum.

(4) Staggering, with general uncertainty of movement, points to the cerebellum or posterior portions of the cerebrum as the position of the cyst.

(5) The base of the medulla oblongata, or the pons varolii or cerebellum, is affected where the animal falls down and makes rolling movements around the long axis of the body.

Experience, however, shows that in most operable cases the skull over the hemispheres must be selected as the site of the operation. The bladder being of considerable size, it is not necessary to discover its central point. Accordingly, when the skull gives no direct evidence of the precise site, most operators trephine about $\frac{3}{8}$ to $\frac{3}{4}$ of an inch behind the horn core on the side to which the head is inclined. To avoid injuring the sinus longitudinalis, the puncture must not approach nearer than $\frac{3}{16}$ of an inch to the middle line. The best possible antiseptic precautions must be adopted. After

opening the cranial cavity the thinned and protruding dura mater must be divided, and the bladder and contents removed with forceps. The wound in the skin is then closed with catgut or silk sutures, powdered with iodoform, and covered with an adhesive; though frequently only a tar bandage is applied to the skull to protect the wound from flies.

Möller's experience with trephining has not been favourable, and he prefers the trocar. The following is the method of procedure:—The animal is laid on its side on a table, the surface of the skull shorn, and the skin disinfected. In rams having large horns, where the skin inclines to form folds, this is rather difficult. The trocar is provided with a cannula suitable to the thickness of the skull, that is, one in which the round shield is not much further from the end of the cannula than the thickness of the skull, so that the instrument shall not puncture the brain (Fig. 337). With some care and practice, however, this appliance is not required. It must be remembered that the thickness of the skull varies considerably; in ewe lambs it may only be a few lines; in rams with large horns it is often more than $\frac{3}{8}$ of an inch. The point of the trocar (previously disinfected by boiling), being directed towards



FIG. 336.
Zehden's
syringe.

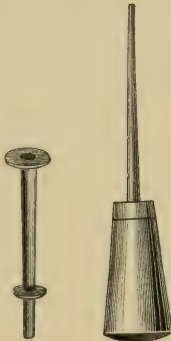


FIG. 337.—Zehden's
trocar.

the middle line and backwards, is thrust through the roof of the skull by semi-rotary movements.

The stilette is then removed, and if the bladder has been punctured its clear serous contents begin to escape through the cannula. After spontaneous discharge has ceased, the empty syringe (Fig. 336) is inserted through the cannula, and any remaining fluid removed. The syringe is held in the right hand with the thumb in the ring of the piston, and the point towards the little finger. Inserting it about as far as the cannula penetrates, the piston is slowly drawn up by the thumb, and the process is repeated as often as required. A portion of the sac-wall may enter the syringe, when resistance

will be felt in withdrawing of the piston. In such case the pull is maintained, and the syringe, drawing with it the sac and contents, is cautiously raised, until the sac-wall comes in sight and can be grasped with blunt forceps and completely taken away. Usually the cyst contains free heads floating in the fluid, which must not be thrown on the ground; and the bladder and contents must both be completely removed and destroyed. The skin wound is disinfected, covered with turpentine, collodion, or tar, and usually heals satisfactorily.

Difficulties, however, are sometimes met with. Animals apparently successfully operated on may die after a few hours, and post-mortem shows bleeding from some of the larger meningeal vessels. Where careful antisepsis is not carried out, inflammatory processes may also result. Injury to a lateral ventricle is especially dangerous, being apt to be followed by fatal hydrocephalus purulentus, running its course in a few days. Frequently the cyst is in the cerebellum, or a cerebral lobe, when its removal is impracticable. When several cysts exist in different positions in the brain the case is hopeless. Sometimes the bladder is not met with when the trocar is introduced, no fluid discharges after removal of the stilette, and it becomes a question whether to introduce the trocar more deeply or to operate at another point. When antiseptically treated from the first, the wound seldom gives much trouble, and no objection exists to renewing the attempt in another place. Sometimes the sac lies so deep as to be impossible of removal, and little good can be done, even with the explorer first designed by Stürig, and improved by Lehmann. The injuries inseparable from the use of this instrument do not, however, occasion any particular danger.

Rams with large well-developed horns give most trouble. In them the frontal sinuses are large, and cover so much of the skull that only the posterior folds of the cerebrum can be directly reached from the exterior. Möller endeavours, in such cases, firstly, to trephine the frontal sinus, and thence to open the roof of the cranium with a trocar. It is difficult, however, to make the frontal sinus aseptic, and, in rinsing it out, large quantities of fluid pass into the nasal chambers, producing difficulty in breathing. Hence, during the operation, the head should be pendulous, though this is attended with considerable discomfort to the operator. The easiest subjects are ewes, in which both skin and bone are alike thin.

At best the losses are heavy. Generally only 10 per cent. are saved, and of these some die later of the sequelæ of the disease. The operation is usually confined to rams and specially valuable animals.

The percentage of cures claimed varies greatly. Englehart records 6 per cent. ; Stöhr, 15 per cent. ; Scholz, 25 per cent. ; Dammann, 33 per cent. ; Reboul, who operates in primitive style with a cobbler's awl and feather quill, states that he has saved 50 per cent. ; and Sütner, even 70 per cent. Kuhlmann claims to have saved from one-half to one-fourth of those operated on, exclusive of the cases in which no bladder could be found. These variable results depend partly on accident, and partly on the skilfulness of the operators.

The failures, in recent years, depend in part on the formation of skull and condition of skin in the modern races of sheep, and in part on the fact that many operators do not remove the bladder, and thus obtain only temporary relief. The prevention of such parasitism is secured by close observation of dogs and their treatment with vermicides, and the yard feeding of lambs and young sheep. Preferable to operation is the prompt feeding and early slaughter of all subjects so soon as they manifest any appearance of the disease.

In **cattle**, sturdy is rare in North Germany, but occurs more frequently in the South. *Cysticerci* were found in the Salzburg slaughter-houses in large numbers of cattle, and sturdy is said to be rather common in cattle throughout Steiermark, Kärnten, the Tyrol, Bukowina, and Dalmatia. Differing from sheep, in which the disease almost always appears during the first two years of existence, cattle suffer at more advanced ages. The symptoms are essentially the same in both classes of animals, and consist of the peculiar position of the head, dilatation of one or both pupils, and abnormal movements, similar to those in sheep.

In cattle the disease often takes an acute course, rendering operation useless. Nor if performed does it insure success, the result often depending on accidental circumstances. Although observations of successful operations have been published (Cooper, Bertholet, and others), reports of unfavourable results are not wanting. As the result is always uncertain, it is better to slaughter affected animals early, though treatment may be attempted in particularly valuable breeding animals.

Treatment is strictly surgical. Albrecht, Merkt, and others claim to have had a fair degree of success. Münch cured 8 cases out of 11 operated on ; Merkt had 50 per cent. of recoveries. Only those animals should be selected for operation which eat well and show no marked interference with sensation, and which always turn towards the same side.

In operating, the marked differences in the skull formation of the two classes of animals must, however, be borne in mind. In cattle the frontal sinuses extend over the greater part of the cranium, and only through them can the cerebral hemispheres be reached. Hence diagnosis and treatment meet with the same difficulties as in large-horned rams. Softening of the external cranial plates evidently cannot occur here ; but the inner temporal plates are sometimes so bulged that they come in contact with the external plates. This may be discovered by percussion, and the position of the parasite located by sounding the frontal and superior maxillary sinuses, using the metallic end of the percussion hammer.

The animal is cast and the operation performed with strict antiseptic

precautions. Merkt, who is supported by Albrecht, describes the procedure as follows :—

An incision about $1\frac{1}{2}$ inches long is made through the skin parallel with, and distant $\frac{3}{8}$ of an inch from the middle line. The incision should not be commenced too high, as in that direction the two plates of the temporal bone lie wider apart. At right angles to this incision a second, about 1 inch in length, is made and then the second longitudinal cut. An assistant, kneeling behind the animal's head, holds back the flap with a hook, the exposed periosteum is carefully removed and a hole about $\frac{1}{2}$ inch in diameter is made with a trephine. This exposes the inner or cranial plate of the temporal bone. Very often, however, this cranial plate is in contact with the outer or has become absorbed ; if not it must be removed with the gouge, bone forceps or bone screw, as it can seldom be reached with the trephine. In any case the trephine must be used cautiously and the cut made slowly, to prevent the instrument suddenly breaking through and so injuring the brain. Where the second plate exists it is necessary to remove with bone forceps all the thin, softened portions of bone covering the cyst so as to facilitate removal of the bladder, which is often of large size.

Having at last produced a hole about $\frac{1}{2}$ an inch in diameter, the brain will be seen, in favourable cases, to be pressing against the edges, and on incising the meninges the distended bladder will at once protrude. As soon as this occurs, the straw bedding should be removed from below the affected side of the head so as to allow it to descend and thus render removal of the bladder easier. The cyst usually bursts spontaneously ; if not it can be ruptured with a director, after which the wall is cautiously grasped with forceps and withdrawn.

The point of operation is then cleansed and the skin flap simply laid in place. The wound always heals readily. After-treatment consists in keeping the animal quiet and the wound undisturbed. The entire body, including the head, is clothed and the animal allowed to lie until the temporary period of stupefaction has passed. When energetic struggles begin and the patient, lifting the head, attempts to rise, the hobbles are removed. Sometimes twelve hours elapse before this occurs. In such cases the results are always much better than when the patient gets up quickly.

The animal is supported to a stall, into which it is placed backwards. A strong sack or length of cloth is sewn together so as to form a collar to envelop the lower part of the neck, and to this are attached two ropes which are fastened respectively to two posts driven firmly into the ground at a distance apart of one yard. This keeps the animal in position without touching the head. If it goes forward it hangs in the sacking collar ; if back it meets the wall. The eyes should be bandaged and the stable kept perfectly quiet. Animals sometimes recover very rapidly—even in a few hours.

DISEASES OF THE NECK.

I.—WOUNDS AND BRUISES OF THE TISSUES OF THE NECK.

IN the domestic animals the cervical vertebræ, which are comparatively long, are surrounded by well-developed muscles, and thus protected from injury. Anteriorly, *i.e.*, below the cervical portion of the vertebral column, lie the trachea and œsophagus, the jugular and carotid, with the nerve trunks of the vagus and sympathetic; above the vertebræ, the ligamentum nuchæ, which gives attachment to many of the muscles of the neck. The latter consists of a round portion forming the upper border of the neck, and a flat portion which extends in the middle line from the vertebræ to the cordiform portion. The collective muscles of the neck are surrounded by two fasciæ, which extend to the withers and back, and become attached to the cordiform portion of the ligamentum nuchæ. In cattle the skin is folded at the lower end of the neck to form the dewlap.

Wounds confined to the skin are of no great consequence. Deeper reaching injuries may involve important organs. To this class belong—

(1) **Bruises and wounds of the fascia of the neck and of the ligamentum nuchæ.** When healing results by primary intention, these cases are also unimportant, but should pus formation occur, the tendinous structures (fascia, ligamentum nuchæ) usually become necrotic. Separation of dead particles requires a long time, and during the process fresh tracts of tissue are often infected. Healing is thus retarded and rendered difficult. This is especially frequent in injuries to the poll, withers, ligamentum nuchæ, or adjacent fasciæ, which lead to chronic formation of pus and sinuses. The process often starts at the withers and extends thence to the ligamentum nuchæ and muscles of the neck; these conditions are treated of under “Diseases of the Back.” It is here only necessary to remark that all such cases are treated by thorough antisepsis, and preventing as far as possible extension of infection and pus formation.

(2) **Injuries to the large blood-vessels of the neck, carotid and jugular.** Injuries to the carotid by sabre cuts, thrusts from lances or other sharp objects, as well as those inflicted during venesection may endanger life, by producing bleeding or suffocation. Injuries to the jugular vein are less grave, though its complete section may lead to fatal hæmorrhage; while there is also a danger of air

entering the blood stream, an accident which is favoured by the negative blood pressure in this vessel, and by its liability to gape in consequence of attachment to neighbouring tissues. The escape of dark-coloured blood in a strong steady stream points to injury of the jugular vein, and calls for its secure ligation, which must be performed on both sides of the wound; on the peripheral side to stop bleeding, on the central side to prevent entrance of air into the blood stream.

Free bleeding in jets indicates injury of the carotid or of one of the larger arteries, and necessitates ligation of the injured vessel. The closure of small skin wounds in no way removes the danger, because the blood accumulating under the skin and loose connective tissue of the throat presses on the trachea, and may threaten suffocation. There should, therefore, be no hesitation in ligaturing the carotid. At the point of bleeding, a cut must be made parallel with and a little above the jugular, dividing the skin and subscapulo-hyoideus muscle. The loose connective tissue is pressed to one side with the index finger, and the vessel, easily recognised by its distinct pulsation, sought, drawn forward, separated from the vagus, sympathetic and recurrent, and after being twice ligatured, severed between the two threads. Section of the vessel is intended to prevent tearing away at the point of ligation, which is favoured by the natural tension of the carotid.

It is necessary to remark that the blood may flow in a regular stream, and not in jerks, even in injuries of the carotid. This is the case where the blood does not find direct exit, but flows under the skin or into the connective tissue spaces. A red colour and powerful stream always suggest injury to the carotid.

(3) **The larger nerve trunks, like the vagus, sympathetic and recurrent, may be injured.** From nerve injuries roaring has repeatedly been seen to result in the horse. Where injury to the nerve exists, or is suspected, the strictest antiseptic precautions must be observed to prevent extension of inflammatory processes, and to bring about regular and early closure of the wound. When nerve rupture has occurred the ends should be sutured.

(4) **Wounds in the neck** may be complicated with perforation of the trachea; and though such a condition is seldom directly fatal, it occasionally leads to death, from blood entering the trachea and lungs and producing suffocation. The emphysema often seen about the neck of sheep after injuries (dogbites) to the trachea is a serious if not always a dangerous, complication. Tracheal injuries are recognised by the bloodstained discharge from the nose, the frothy

condition of the wound, as well as by emphysema in the neighbourhood of the injury. Bloody discharge from the nose, coughing, rattling in the throat, and dyspnœa point to the entrance of a large quantity of blood into the trachea. Where these symptoms occur, the bleeding vessels must be immediately tied and patients with injuries to the trachea, or in its neighbourhood, should not be left unattended. Extravasations in the neck sometimes lead to compression of the trachea and death from suffocation, and, where this threatens, tracheotomy becomes necessary. It is also called for where much blood has entered the lungs. A tampon cannula is inserted, or the trachea plugged above the cannula to prevent the blood passing downwards. In such cases the tracheal tube must be fixed with especial care to prevent the tampons falling into the trachea. For this purpose, and in order to be able to remove the tampon more easily, it is well to encircle it with a piece of tape, which can be fastened round the neck. For further information, refer to the article on tracheotomy.

(5) **Injuries to the œsophagus** are not so frequent. They usually occur in the lower third, on the left side of the neck. Œsophageal mischief is shown by the presence of chewed food or saliva in the wound. Though such wounds are not dangerous to life, they require a long time to heal, and are apt to lead to fistula.

(6) **Wounds lower down on the neck**, usually produced by the carriage pole, or by running against obstacles, may extend 8 to 12 inches deep between the shoulder blade and thorax, and cause extensive destruction of the muscular tissues of the shoulder and breast. They are still more serious when they extend to the first ribs, or the space between them. Complicated fractures of the ribs are often produced in this manner.

The wound, if confined to the muscular tissue, requires no particular attention, although fatal results occasionally ensue from extensive pus formation, or from infection of the chest. The extent of such injuries is sometimes difficult to ascertain at first, and for a few days diagnosis should be guarded. Where one or another of the ribs is injured, purulent pleuritis and death can seldom be averted. Early and continuous irrigation should be adopted, and the wound in the skin and muscles laid open to allow free exit of discharge. This is even more requisite where the injury extends to the muscular tissue of the breast, and under the shoulder. With free opening and the use of drainage-tubes such wounds, however, usually heal satisfactorily. Injuries involving the sternum are dangerous, because this bone is liable to become necrotic, producing so-called sternal

sinus, which seldom heals within a reasonable time. To prevent such complications the wound must be carefully cleansed, continuously irrigated, and well drained.

II.—FRACTURES OF THE CERVICAL VERTEBRÆ.

THE above fractures are not uncommon in horses. Fractures of the atlas and of the other vertebræ of the neck occur, sometimes singly and sometimes together. The usual cause is falling, as in hunting or steeplechasing—or in being driven over. Riding-horses in violently bucking or falling over backwards not infrequently fracture a cervical vertebra, usually the third or fourth. In bucking or leaping, if the fore-limbs are not rapidly extended, the animal comes to the ground on its mouth, and thus falling, even on soft ground, may fracture the third or fourth vertebra. Hertwig states having seen fracture of the odontoid process of the second cervical under these conditions, but such fractures are rare. Vertebral fractures are seldom produced by kicks, or thrusts with the carriage pole. Cattle cause them by violently tilting at each other. In small animals they result from blows with heavy sticks or attempts to crawl through narrow openings in which they become fixed and struggle to get free.

Symptoms. The immediate effects of cervical fracture depend on its extent and the degree of injury, if any, sustained by the spinal cord. Partial fracture (oblique or transverse processes) may exhibit only local symptoms, swelling, stiffness, etc. In horses fracture of the 2nd, 3rd or 4th vertebra may be followed by instant death from implication of the phrenic nerves; but in fracture of the first, or last two cervical vertebræ, the animals may live for some time. Fractures of the last two are followed by paralysis of the muscles of the shoulder, while fractures of the oblique processes produce torticollis.

A riding-horse, injured by falling, was ridden for some miles, but died four days later, and post-mortem revealed fracture of the sixth cervical. Scharfenberg described the following cases:—A horse, after running against a door, fell, rose again, and worked for three hours. Next day paralysis set in, death occurred on the third day, and post-mortem showed the body of the second cervical vertebra broken completely across. A horse after falling on the racecourse was ridden some four or five miles further. Signs of paralysis then appeared, and two hours after the fall the horse died. The autopsy showed a transverse fracture of the body of the fourth cervical vertebra. A horse, examined after death by Rabe, had fractured the first cervical on August 21st by falling, carried its head awry, showed swelling in the neighbourhood of the atlas, and threatened to fall

immediately any attempt was made to raise the head. After standing quietly in the stable until September 8th, it was moved, rapidly became worse, and in consequence was killed. An ox thrown down whilst struggling with another could still run; on being placed in a stall, however, it soon became paralysed, and the second cervical vertebra was found, on post-mortem, to be broken into four pieces.

Köhne records fracture of both wings of the atlas in a horse which had fallen. On the following day it showed difficulty in breathing, rolling gait, and marked stiffness of the neck, muscular twitchings and great pain on moving the latter. These symptoms continued; and having fallen on the twenty-second day, the horse was unable to rise again, and died three days later. Post-mortem showed callus formation on the broken wings and inflammation of the meninges of the medulla oblongata. A cow whose horns had become fast in an iron rack was found unable to stand, to move the head, or to eat. Post-mortem discovered fracture of the second cervical vertebra, and bleeding into the vertebral canal.

In one year the following vertebral fractures were noted amongst the Prussian army horses:—Thirty cervical fractures, six dorsal, and seven lumbar.

In man, injuries to the spinal cord are generally accompanied by abnormal rise in temperature, reaching 43 to 44 centigrade; but in animals no observations are available on this point.

The course of the disease is similar to that in man, although in him death occurs somewhat later, because the medulla oblongata or the spinal cord is not so often injured. Displacement of the pieces of bone, bleeding into the spinal canal, or inflammatory processes generally disturb the function of the spinal cord later, and bring about death. Any cervical fracture which involves the phrenic nerves may be followed by fatal asphyxia from paralysis of the diaphragm. If the fracture is confined to one or another of the vertebral processes, the animal may recover.

Treatment of fracture of the body of a vertebra is usually impossible, because death is almost immediate. Otherwise, especially in animals worthless for slaughter, it is of the first importance to prevent displacement of the broken fragments. Where such a fracture, or one affecting any of the processes, is believed to exist, the animal is placed in a condition of absolute rest, and measures adopted to prevent, as far as possible, all movements of the head and neck. If soft parts are injured, antiseptic methods must be employed to prevent pus formation, necrosis and spread of inflammatory processes.

Complete displacement of the cervical vertebræ, said to occur in the horse, may here be mentioned. As it usually causes immediate death, there is seldom opportunity for a precise diagnosis. Conditions described as luxations of the vertebræ have doubtless often

been merely fractures. This is true of a case described by Vives. A mule, which shortly before had been galloping about, was observed standing immovable, with head lowered, and turned to the left. Attempts to lift the head produced much pain, the neck was swollen, and the occipital region distorted. The right wing of the atlas extended further forward than usual; the left could not be felt. Next day severe swelling of the head had set in. On the thirty-fifth day the condition remained essentially the same. Tuberculosis in equines is often associated with muscular atrophy and unilateral prominence over two or three cervical vertebræ.

III.—DISTORTION OF THE NECK (TORTICOLLIS).

THE collective term torticollis has been used in human medicine since olden times to describe many different conditions, which, on careful examination, have nothing in common with that now under consideration. In animals, distortion of the neck sometimes occurs, but the precise anatomical changes on which the abnormality depends have not been recognised. On this account, while adopting the above designation, we shall endeavour to point out the nature of the more frequent of these distortions.

(1) **Cramp or contraction of the muscles of the neck** occurs both in men and animals. In men the most frequently affected muscle is the sterno-cleido-mastoideus; its shortening is often congenital, or develops through cicatrisation after birth. Such conditions have not been observed in animals. But Uebele records that an eight days foal showed at short intervals attacks of cramp in the left cervical muscles, drawing the head to the left; when not supported, it fell; the condition disappeared in fourteen days. Möller has repeatedly seen temporary displacement of the head and neck in horses, consequent on rheumatic affection of the above-named and other muscles. These abnormalities were accompanied by lameness, most marked when the limb was being lifted. In dogs similar rheumatic contractions in the muscles of the neck also occur, usually on both sides. They can be recognised by local pain and swelling, and may exist only for a few hours.

(2) **Paralysis of the muscles of the neck.** Whilst the diseased conditions causing the above-named distortions are to be sought on the concave side of the curvature of the neck, the cause of paralytic torticollis exists on the convex side, as may be seen in dogs and rabbits during the course of diseases of the middle ear. In the

German Army Reports a horse is mentioned in which paralysis of the muscles and production of torticollis resulted from a carcinomatous growth on the petrous temporal bone. Torticollis appears in horses as an accompaniment of the general paralysis of cerebral meningitis, and in diseases of the medulla oblongata and cervical spinal cord. Wilden speaks of a horse which showed torticollis during an acute brain attack, but recovered as the cerebral symptoms disappeared. Leisering saw a dog which suffered from torticollis, and simultaneously from hemiplegia and paralysis of the ear and eye, with softening of the pons varolii, medulla oblongata and cerebellum. In birds—hens and ducks—Möller has often seen the head bent in a semicircle (so that the beak was turned backwards) in consequence of brain disease, or following intoxication produced by coal gas. The same is noticed in canaries.

(3) **Inflammation of the soft parts**, especially of the muscles, consequent on severe strains and lacerations, is produced in horses by falling, and is often described as subluxation of the cervical vertebræ. Fambach had under observation a horse which, by hanging back in the halter, produced rupture of the round portion of the ligamentum nuchæ just behind the occiput; pus formation and necrosis occurred, and were followed by death. Flessa describes a case of torticollis in a horse produced by rupture of the levator humeri muscle between the upper and middle thirds; recovery occurred in two months.

(4) **Subluxation and fracture of the cervical vertebræ**. Complete luxation of the body of a vertebra, as above stated, is almost always fatal. On the other hand, subluxation, accompanied by distortion of the neck, may occur without injury to the spinal cord. In France the condition is described as “*entorse vertebro-cervicale*,” and consists in subluxation of one or another of the oblique processes of the bone. As the bodies of the vertebræ are attached to one another by cartilage, their separation is more appropriately described as diastasis, but this is a condition not infrequently complicated with fracture of the oblique processes. According to Schrader, Hippocrates declared that the conditions described as displacement of the cervical vertebræ were often only muscular diseases, and that Absyrtus, in his contemporary History, expressed himself in the same sense.¹ Lebel, Hurtrel d'Arboval, and others combated the possibility of displacement of the cervical vertebræ, and supported their contention by citing cases of spontaneous recovery.

¹ Sed te nolo latere, non luxationem esse sed perversionem (Schrader).

Hertwig has shown, however, that such displacement may occur in consequence of rupture of the ligaments of the oblique processes. Williams found degenerative processes in the inter-articular cartilages.



FIG. 338.—Subluxation of the third cervical vertebra, as seen from the left side.

In other cases the oblique processes are fractured. Guitaud and others could even detect distinct crepitation. Busse states having directly felt the broken oblique process of the vertebra. Möller detected this fracture on post-mortem examination. He treated



FIG. 339.—Subluxation of the third cervical vertebra, as seen from the right side.

a horse which had been found one morning cast in its stall and unable to rise even with assistance. In spite of all efforts it was only got up next day, and then showed unmistakable symptoms of torticollis. The neck was bent at its middle point, at a rather sharp angle, and directed downwards and towards the right side. The head could certainly be pushed towards the left, producing

crepitation, but immediately fell back into the abnormal position when released. Post-mortem showed the oblique processes of the 4th and 5th cervical vertebræ to be fractured, and their surroundings infiltrated with blood. There was no injury either to the bodies of the vertebræ, the spinal cord, or its covering, nor had bleeding occurred into the vertebral canal. The torticollis was clearly not

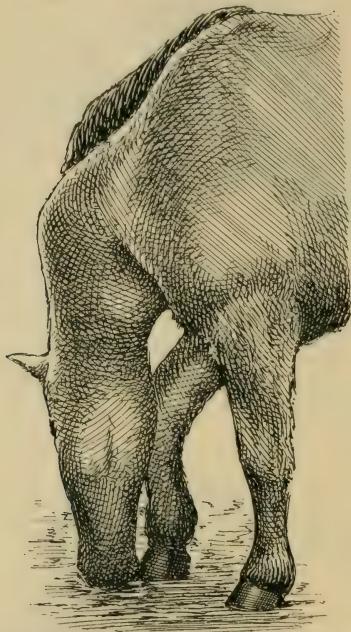


FIG. 340.—Distortion of the neck (torticollis) in consequence of the calkin of a hind shoe becoming caught in the head-collar. (Redrawn from a photograph.)

the mere result of fracture, but of hæmorrhage, producing paralysis of the cervical nerves. Labat saw a similar case.

Möller saw a thoroughbred which had fallen and sustained distortion of the neck in the region of the 2nd and 3rd vertebræ. The swelling, which had at first been considerable, had mostly disappeared. On the left side, between the 2nd and 3rd cervical vertebræ, a distinct prominence was seen (Fig. 338); whilst at the corresponding point on the right, a depression existed sufficiently large to accommodate the two hands when extended (Fig. 339).

The condition was doubtless due to subluxation between the 2nd and 3rd cervical vertebræ.

Werner saw a horse which after running into and striking a carriage with its head lay senseless for three minutes, but on getting up was able to resume work. Ten hours later the head was bent towards the right ; on the left side of the neck over the second cervical vertebra was a marked swelling. The gait was unsteady. The neck could not be brought into a straight line. Post-mortem examination showed a transverse fracture of the second cervical vertebra and submeningeal hæmorrhage.

Mongiardino had the opportunity of making autopsies on two horses showing torticollis. In one the intervertebral discs between the 3rd, 4th, and 5th cervical vertebræ were partly torn through. The head of the fourth vertebra slipped partly out of the cup of the third when the neck was bent. In the other case the capsular ligaments on the convex side of the neck were strained so that the articular surfaces no longer corresponded. The cervical muscles on the convex side were paralysed and had undergone atrophy.

A horse mentioned by Grams had hung back on a halter ; when its head was turned towards the right the middle of the neck sprang outwards, when towards the left the dislocation was reduced. The animal recovered after the application of a special splint.

The case described by Martin (*The Veterinarian*, 1896) as dislocation of the cervical vertebræ may have been a subluxation or only a muscular injury. The pony had been "cast" with its off hind shoe fixed in the head collar, probably for a considerable time. Attempts at replacing the parts produced staggering, strabismus, convulsive picking up of the hind-legs, and spasms of the body muscles. Splints were applied to the neck and the animal was tied up, but fell during the night and pulled down a beam. On the sixth day after the accident improvement was noticeable and the splints were readjusted. In less than three weeks recovery was complete.

Hering's failure to produce the condition artificially in the horse does not disprove the occurrence of such subluxations and fractures, but only shows that simple injuries to the muscles produce changes in the carriage of the neck. Gerlach observed the disease in cows and horses, and described it as distortion of the cervical vertebræ. With incomplete displacement of the latter, the head is directed sometimes to one side (abduction-luxation) ; but sometimes the neck undergoes more or less pronounced rotation (rotation-luxation), which, strictly speaking, alone corresponds with torticollis. The condition is seen most frequently in horses, which, when scratching

the head, get the hind-foot fixed in the halter and are thrown, or in jibbers, which have been pulled forward by a rope passed round the neck.

Diagnosis. The conditions described cannot always be differentiated, even on careful examination. Cognisance must be taken not only of the symptoms, but of the history of the case. Distortion produced by muscular disease is usually distinguished by pain, swelling, and other inflammatory changes, while the neck, although it may be brought into its normal position, reverts to its distorted state when force or support is removed. Cicatrices are a rare cause in the lower animals. When inflammatory appearances are absent, paralysis of the muscles on the convex aspect of the neck may be suspected, especially if cicatricial contraction can be excluded as a cause.

Distortions arising from fractures and subluxations may be distinguished from those connected with muscular lesions by crepitation, and still more notably by the fact that the parts, even if difficult to bring into position, retain that position when once reduced. Many observers state that in subluxation the neck is excessively mobile; but although it may be so in certain directions, general freedom of movement is diminished. Egelling saw what he considered to be persistent luxation of the cervical vertebræ. The horse could even be ridden.

Slight curvatures usually produce little inconvenience, but considerable displacement of the head leads to difficulty in movement, and the animal is sometimes unable to get up or to stand, though it can do both immediately the head is supported in its normal position. Others make "circus movements" towards the side to which the neck is curved. Where curvature becomes excessive, as is frequently the case in dogs and rabbits, the animals attempt to rise, but at once fall back, and make rolling movements around the long axis of the body. This is occasionally seen in dogs with disease of the middle ear, and in rabbits affected with mange of the ear. Sometimes, in horses which have suffered from severe strain of the collective muscles of the neck, the head is carried very low, producing considerable œdematous swelling, and causing the animal's head to resemble that of a hippopotamus.

Ruptures of the funicular portion of the ligamentum nuchæ can be directly felt and recognised by the head being carried very low. The same position is assumed in disease of the upper vertebræ, and of their joints. Möller had a horse with purulent arthritis between the first and second cervical vertebræ, produced by the

breaking through of a retropharyngeal abscess. The horse held the head and neck stiffly, and threatened to fall when attempts were made to lift the former. In purulent arthritis fever usually exists, but is altogether wanting in diseases of the muscles produced in a mechanical way.

Course and prognosis. Distortion of the neck due to rheumatic disease of the muscles usually disappears in a few days. It often continues only a few hours, although in certain individuals it may recur, and is signalled by great pain, which in dogs causes whimpering or howling. Though torticollis caused by paralysis may disappear in a short time, it sometimes remains for long periods, or even proves incurable. In forming a sound prognosis, it is important to discover the cause of the paralysis. In Möller's practice, cases connected with ear disease have all proved incurable. Paralysis which has occurred suddenly, or existed only a short time, and is due to rheumatic or traumatic causes, may generally be expected to disappear earlier than that which has developed more slowly, or which depends on disease of the central nervous system. In the latter case, prognosis is always doubtful, and is still graver when the condition is complicated with convulsions. On the other hand, distortion of the neck produced by muscular strain is cured in eight to fourteen days, or even earlier. Hertwig emphasises the fact that diagnosis must be cautious during the first few days; a safe judgment cannot be formed from early appearances; severe disturbances often disappear quickly, whilst apparently slight cases may take an unfavourable course.

Conditions caused by muscular disease seldom leave any lasting defects, though extensive ruptures may later be recognised by depressions. Schrader found, on the neck of a three-year-old colt, a furrow in which the fist could be laid. After luxations or fractures, cicatricial thickenings are often observed. Harvermann noted these in horses, on the concave side of the diseased neck. An army horse with subluxation of the 3rd and 4th cervical vertebræ again became useful after some months. It is important to note whether the animals can stand and take food; if not they may die of decubitus, or lose condition and value. As a rule, in such cases slaughter is to be recommended, especially where no considerable improvement has resulted within several days after the attack.

Treatment of rheumatic torticollis comprises warm coverings, friction with volatile stimulants, and administration of salicylates, potassium iodide, antipyrine, and similar drugs. It is especially desirable to keep the animal standing where distortion depends

on sprains of the muscles or disease of the spinal column. The neck may usually be kept straight by a girth, cradle, or narrow piece of wood, fastened with the roller and a strong halter to the concave side of the neck ; sometimes by simply fastening up the head.

Where luxation is present, replacement must be attempted. In heavy horses counter extension may be effected by the weight of the body. Where this is impracticable, the animal may be fixed with the help of a horse collar, while, with a strong, well-fitting halter, extension may be effected by several strong assistants, or by the help of a compound pulley. Godine states having thus produced an extension of $3\frac{1}{4}$ inches in the neck of a horse. Immelmann passed a strong hop sack, doubled, round the head of the horse, and allowed fifteen persons to pull on it. During extension, the

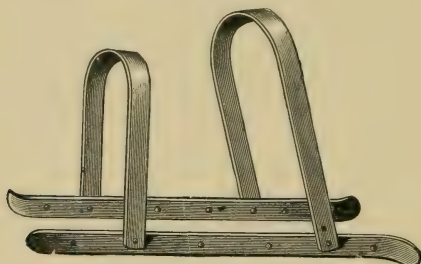


FIG. 341.—Knudsen's iron splint for distortion of the neck.

operator endeavours to effect reduction by pressing or turning the neck at the middle of the convexity. This attempt generally succeeds, the distortion immediately disappearing. Busse laid his patient on the ground, with the concavity of the neck downwards, placed a board on the convex side, and exerted strong pressure on it. The displacement, even when reduced, may recur on the horse rising. In such cases fracture of the oblique process usually exists, and the application of a bandage is necessary. Hertwig recommended two splints of wood or tin, which fitted exactly the side of the neck and reached from the shoulder to the posterior border of the lower jaw, and were fastened together at the upper and lower ends of the neck by bands. Stockfleth recommends an iron splint (Fig. 341) constructed by Knudsen. Owing to its yielding nature, it is easily fitted. The splint, when applied to the convex side of the neck, must be padded with tow or wadding to prevent bruising. The horse is supported on rising, and afterwards fastened up short to the wall. The use

of slings may be desirable. Cattle can be treated in the same way. The apparatus should remain in position eight or fourteen days, sometimes a little longer, care being taken that the animal does not lie down, and that the splints are kept carefully padded.

Inflammatory processes sometimes require the use of cold applications. Massage may be used later to bring about absorption. Where the head is sunk and œdematous swellings result, producing dyspnoea by narrowing the nostrils, tracheotomy may be performed if necessary. Swelling usually disappears on raising the head and supporting it with a girth or head-rest.

IV.—GOITRE. STRUMA.

THE thyroid gland, though not so frequently the seat of disease in domesticated animals as in man, does become affected, especially in carnivora,—less frequently in horses, cattle, and sheep. Goitre in calves and lambs has been observed by Gilruth in New Zealand (Govt. Annual Rep. 1901). Transitory swelling of the gland, without other inflammatory appearances, is seen in horses and dogs during the progress of catarrhal affections of the pharynx, but disappears during convalescence. More frequently new growths invade the gland. Hyperplastic processes, since olden times named Struma, also occur. New growths resembling these develop in the gland, but being difficult precisely to identify, are included in the clinical term Goitre.

Four varieties of goitre have been distinguished: (1) Real Goitre or hyperplasia of the gland follicles, with colloid change of their contents, which are chiefly albuminous. It may affect the whole gland or only a portion of its structure. (2) Fibrous Goitre in which there is marked increase of connective tissue, the follicles being little altered. (3) Varicose Goitre, which is remarkable for its great vascularity, the veins especially being much dilated. (4) Cystic Goitre or pathological distension of single follicles of the gland.

Specific new growths, like carcinoma, have been seen in dogs by Bruckmüller, Zschokke, and others. Zschokke says that at least 30 to 40 per cent. of old dogs suffer from goitre, and whilst in young animals the condition consists simply of hyperplasia of the gland, the goitre of old dogs is almost always of a cancerous nature, and is prone to degeneration and bleeding. Tuberculous swellings have been met with by Bruckmüller and others in cattle. Johnes has described carcinoma of the thyroid, accompanied by secondary carcinoma in the lungs of a horse.

Thyroiditis or inflammatory goitre, has been observed by Lucet in calves from six to eighteen months old. The symptoms appear rapidly, and include more or less considerable enlargement of one or both glands. Very prominent, and painful to pressure, the glands compress the upper part of the trachea, causing noisy respiration or even roaring. The head is held extended on the neck, swallowing is difficult, appetite and rumination are suspended, and there may be a sudden accession of fever, which, however, soon subsides. Usually these symptoms disappear in a few days, though sometimes they persist, and the affection following a septic course may terminate by death. Treatment consists in application of iodine tincture or warm antiseptic compresses, and the administration of potassium iodide. If the gland suppurate it should be punctured without delay. Tracheotomy may have to be performed to relieve the dyspnoea.

The causes of goitre are just as little known as those of other tumours. French veterinarians have insisted that in regions where goitre frequently occurs in men, it is also common in animals. That locality has some predisposing effect seems undeniable, but complete uncertainty exists as to the immediate cause of the disease. Whether the existence of magnesia or the absence of iodine and bromine in the soil exercises any influence, as has been asserted, is at present undecided.

In animals, and especially in carnivora, goitre appears most frequently during the earlier years of life. Lydtin related the case of a stallion which transmitted goitre to five of his offspring. Johne saw a case of inherited goitre in the dromedary. According to Haubner, the lambs of one flock were attacked enzootically in certain years. In one season six, and in the following, ten newborn lambs were affected, and the disease, it was believed, was transmitted by the ram. Similar observations have been made by Gurlt in goats. It should, however, be noted that the size of the thyroid varies considerably in certain animals, especially in horses. Not infrequently its lobes, normally the size of a chestnut in the horse and ox, become as large as a duck's egg, whilst the commissure remains little affected. This liability to variation is widely observed in particular families, and appears, to a certain degree, to be inherited. Such conditions cannot consistently be described as goitre, for the gland, although abnormal, does not continue to grow larger. Many references to inheritance and enzootic outbreaks of goitre in animals are clearly to be referred to this condition.

Symptoms. The most striking feature is the swelling close under the larynx, and towards the side of the trachea. In horses the gland on either side, usually not larger than a chestnut, attains the dimensions of a man's fist. It sometimes becomes as large in dogs. As the gland grows in size and weight it sinks, and becomes more prominent. Either one or both glands may be affected.

As long as the size of the thyroid is not much increased, goitre in animals is of little significance. In the horse, however, Massot, Neyraud and Truelsen have observed difficult deglutition, and dyspnœa from the swelling pressing on the trachea. This occurs more often in dogs, which may be unable to lie down, on account of the swelling compressing the trachea and interfering with breathing. The trachea may be narrowed until it closely resembles a scabbard. Zschokke found carcinomata in dogs invading the trachea and œsophagus, and producing difficulty both in breathing and swallowing. Johne reports the case of a dromedary calf which died at birth from suffocation produced by a goitre swelling weighing nearly 13 pounds. In a horse, sarcoma of the thyroid spread entirely over the larynx during the space of a year and a half, and finally caused death by suffocation.

Prognosis. In animals, and especially in young dogs, goitre is not simply a blemish, although some varieties occurring in horses cause no inconvenience. The significance of the case depends upon the size of the swelling and its rate of increase, but our knowledge of the condition does not justify very sanguine expectations. Extirpation entails not only the danger of excessive bleeding, but also the development of peculiar symptoms described as cachexia strumipriva, which are frequently seen in young dogs. Some weeks after total removal of the thyroid, marked weakness appears, accompanied by anæmia and wasting, from which the animals finally die. These symptoms, however, can be prevented by giving a daily dose of fresh thyroid gland.

Von Eiselsberg observed the disease in lambs. Two months after extirpation of the gland, the animals' growth became checked. They remained much smaller, weaker, and of less weight than the control animals. The anterior portion of the head was shorter, the posterior portion enlarged, the abdomen distended, the testicles atrophied, the wool badly developed. One of the sheep suffered from catarrhal attack of the lungs, but von Eiselsberg regarded this as an accidental symptom. The temperature was 1.5 to 2 degrees Cent. below normal. Von Eiselsberg noted similar symptoms in a goat whose thyroid had been removed at the age of six weeks.

It was formerly believed that this gland was a secretory organ, which could be dispensed with without danger to life. But Grützner demon-

strated that, although one-twentieth the size of the brain, the thyroid has as large arterial vessels. Horsley testifies to its important secretory functions, and points out that myxœdema does not appear, if half or a part of the gland be left. Others (Munk) believe that the disturbances caused by extirpation result from unfavourable wound healing, or from injury to the vagus or sympathetic, and moreover are aggravated by feeding the patients on flesh. Breisacher tested this question by a series of experiments on dogs, and found that the strumous symptoms, especially the clonic and tonic muscular contractions, and respiratory cramp receded, when the animals were restricted to milk diet, but reappeared when they were again fed on meat and soup; boiled meat, however, appeared not to be injurious.

Other dangers of extirpation are the risk of injuring the recurrent nerve or vagus, and of causing dangerous bleeding. Massot removed the thyroid in two horses without bad results, and in one of them the dyspnœa consequent on pressure disappeared after operation. Möller once performed the operation in a horse without the results described, but operating on dogs he repeatedly observed cachexia strumipriva. Removal of a portion of the gland is, however, not attended with serious consequences. Haubner stated that lambs affected with goitre were sometimes born dead, sometimes died soon after birth. A lamb operated on by Haubner remained healthy, though for how long is not said. Carcinomatous goitre can be recognised by the uneven, knotty character of the surface of the swelling. It is very dangerous.

Treatment. Medicines administered internally, or applied by infriktion, are usually without success; but iodide of potassium may be prescribed or used as ointment. Painting with tincture of iodine has been recommended, but this is only serviceable when the thyroid is acutely swollen in consequence of disease of the pharyngeal mucous membrane. Siedamgrotzky suggests infriktion with iodoform and unguentum hydrarg. Truelsen recommends rubbing in three times a day an ointment of 1 part of pure iodine, 5 parts iodide of potassium, 30 parts *sapo virid.*, and gives internally iodide of potassium and nitrate of potassium in doses of 30 grains of each. A marked diminution of the swelling and removal of the dyspnœa is said to occur in three weeks. In true goitre more active results are obtained by parenchymatous injections made with a Pravaz syringe, the needle being inserted into the tissues of the gland, and from 5 to 15 drops of tincture of iodine passed in. Inflammation usually develops, but disappears in eight to fourteen days, when the injection may again be used and repeated at intervals. Good results have been reported from

injection of a 15 per cent. solution of iodoform in æther or glycerine. Möller obtained favourable results in a dog from parenchymatous injection of a watery solution of papain (1 to 10). The swelling in forty-eight hours was uniformly soft; on incision the digested parenchyma of the gland was discharged as a milky fluid, and although it did not completely disappear, the swelling markedly decreased and the dyspnœa became less. In dogs the gland sometimes undergoes cystic changes, producing a swelling outwardly resembling an abscess. Should it be laid open, however, death generally results (Zschokke).

More recently very good results have been obtained, both in animals and men, from the administration of thyroid juice or extract. Even after a few doses of $1\frac{1}{2}$ to 7 grains, dogs have shown marked improvement and diminution in the swelling. The milk of goats which have been deprived of their thyroid glands, is said to be curative.

Thyroidectomy may be performed in the horse without any bad result; but only partial excision should be practised in the dog. The chief difficulty in operating is hæmorrhage, which must be arrested as dissection proceeds.

Rydygier, in human patients, recently tried ligature of the arteries of supply, but their simultaneous ligation was only favourable in parenchymatous goitre. Schmidt used the "écraseur" for extirpation in the horse. Massot exposed the gland, drew it forward with the fingers, and resorted to torsion before ligaturing. After dissecting back the skin, Möller lays free the gland with the fingers, and ligatures the visible vessels, finally applying a still stronger ligature and removing the gland above it. Care should be taken not to divide the gland too closely, as the ligature may slip off. It is better to leave some gland tissue, so as to give the ligature a better hold. After-treatment must be regulated according to general principles. Lanzilotti removed a goitre swelling as large as a child's head from a horse. It had developed in six months. The right section of the gland was as large as a potato, and was retained. The animal returned to work after a month's rest. Examination of the tumour showed it to be a simple adenoma. Munk's and Breisacher's experiments seem to indicate milk diet as a valuable means of treatment. Where only one side of the gland is diseased, removal of this portion can be undertaken without serious consequences.

Jewsejenko reported the case of a four-year-old English thoroughbred mare, which lost appetite after a race and showed great thirst, weakness, palpitation of the heart, and frequency of pulse, with swelling of the thyroid and eyelids and reddening of the conjunctiva. Fourteen days later exophthalmos occurred, the thyroid gland showed pulsation, and death occurred in four weeks, with symptoms of anæmia and exhaustion. Whether paralysis of the sympathetic was also present here cannot be decided. A horse in Cadiot's practice was found to be much wasted, low in

condition, and to have one fore-foot painfully swollen. Œdematous swellings were present at different points on the body, and the left half of the thyroid was much enlarged. The arteries lying near the surface, amongst others the carotid, the posterior auricular, and the metatarsal arteries, showed powerful rhythmical movements; the frequency of the pulse was from 70 to 80 per minute. In the cardiac region the labouring action of the heart was distinctly noticeable, the thoracic wall visibly moving. Examination of the blood showed no tendency to leukæmia. The patient died on the third day without having shown exophthalmos. The heart weighed 14 lbs., and the great blood-vessels were twice the normal diameter.

Brivot observed marked enlargement of the thymus gland in a two-year-old cow. The swelling extended from the 3rd ring of the trachea to the sternum, and transversely from one jugular to the other. It was hard, painless, and weighed at the time of death $13\frac{1}{2}$ lbs.

V.—INFLAMMATION OF THE BURSA OF THE LIGAMENTUM NUCHÆ.

In the horse the funicular portion of the ligamentum nuchæ is provided at the summit of the second cervical vertebra with a mucous bursa, which attains the size of an apple, and is covered on both sides of the ligament by the complex muscles. Loose connective tissue attaches the inner surfaces of these muscles to the bursa. Poll-evil is due, then, to a *bursitis*, produced by bruising, less frequently by metastatic inflammation like that of strangles, and, though usually acute at first, tends to become chronic. The first injury may be caused by the animal striking its poll against a rack or low door; by a fall, or blow with a heavy whip-handle; less commonly from pressure of the halter, or, as Hertwig believed, from violently bending the neck when being reined up. Among animals at grass, this bursitis is more generally caused by external injuries than by straining the muscles of the neck during grazing.

Symptoms. A characteristic swelling appears over the first two cervical vertebræ close to the middle line, is accompanied by inflammatory symptoms, and sometimes affects one side, sometimes both. At first fluctuating and sharply defined, it soon extends to the surrounding soft parts, becomes diffuse and less yielding. The condition primarily consists in the accumulation of inflammatory exudate and blood in the bursa. Later parabursitis sets in, and the swelling loses its sharply-defined form. The accompanying pain generally causes the animal to hold the head extended, or low and fixed. Sometimes brain symptoms appear. Slight fever either accompanies the condition from the outset, or develops subsequently.

If by appropriate treatment assepsis can be maintained, the fluid in the bursa may be reabsorbed, and recovery occur in

four to six weeks. But more frequently infection, produced through skin abrasions caused when the bursa was injured, extends. Chronic inflammation sets in, the bursal walls and surroundings become thickened; small spherical growths, proceeding from the inner surface of the bursa, separate after a time, so that the cavity may become filled with a great number of rice-like grains. There are frequently large masses of these corpora oryzoidea. Vincent erroneously considered them to be entozoa. When chronic inflammation has occurred, recovery is slow; but the working usefulness of the horse may not greatly suffer. The swelling in such cases becomes smaller, harder, and less movable with the lapse of time. In most cases, however, pyogenic infection of the bursa follows, the inflammatory appearances increase greatly, spread to the neighbouring connective tissue and muscles (parabursitis), and finally, after acute pain and fever, end in abscess formation with perforation of the skin. The finger, introduced into the abscess cavity, detects necrosis of the ligamentum nuchæ or other tissue and purulent inflammation of the bursa, which may continue for months and baffle treatment. Sometimes inflammatory symptoms, and especially pus formation, abate, although purulent fluid, mixed with blood, continues to flow from the small fistulous opening. Necrosis may extend to the occipito-atloid ligament, the occipital bone, first and second cervical vertebræ, and the deeper lying portions of the ligamentum nuchæ and cause inflammatory inter-muscular swelling in the throat. Recovery is most tedious, especially if proper treatment is not adopted, and unless in valuable subjects, slaughter may be advisable. The thickening left produces no difficulty in moving the neck; but permanent stiffness occasionally results from adhesion between two vertebræ (Lafosse); and fatal cases occur from embolism, from spreading infection, or finally, from pus breaking into the vertebral canal. Death then occurs suddenly, with general paralysis and epileptiform seizures.

The course depends principally on whether the tissues remain aseptic. Should this be the case recovery follows in four to six weeks; otherwise the above described complications are very apt to occur and the disease to become chronic. The prognosis is then unfavourable. Special care must be exercised in giving an opinion where there is much suppuration, swelling and pain. Except in valuable animals treatment is seldom justified when suppuration has extended to deep-seated structures and the lower portions of the ligamentum nuchæ have become necrotic.

Treatment. In recent aseptic conditions of the bursa, inflam-

mation should be combated by cold antiseptic applications, made with a towel folded several times and fastened to the mane. Slight steady pressure also favours reabsorption of extravasated blood. The halter must be removed, and the animal placed loose in a box, and kept from work. Where a box cannot be obtained, a neck strap may be applied instead of a head collar. As soon as acute inflammatory symptoms have somewhat receded, gentle massage with mildly stimulating applications is indicated. Blistering with sublimate or iodide of mercury ointment has been recommended, but should only be practised with great caution.

As soon as abscess formation reveals infection, it is advisable to provide for discharge of pus at the earliest possible moment, but care must be taken not to injure the occipital artery. Should this or one of its branches be cut, bleeding may be stopped by ligature or a compress. The incision must be wide and deep enough to allow free exit to the pus, and, if necessary, counter openings should be made and gauze or tube drains inserted. When necrosis of the ligamentum nuchæ has taken place, resection of the funicular portion may become necessary; it is easily effected even in the standing position with a tenotome. The necrotic material is removed, and the pus washed from the abscess cavity once or twice daily. The fear that difficulty in lifting the head may follow is said by Hertwig to be unfounded. Even after resection of portions of the ligamentum nuchæ the patient soon lifts its head as high and moves it as freely as before. Subcutaneous section of the ligamentum nuchæ, recommended by Lafosse, can only be advised where there is some prospect of maintaining asepsis. But section of the ligamentum nuchæ is not to be lightly adventured on. Under any circumstances, division of the skin across the top of the neck is to be avoided, as it gives rise to wounds which heal with difficulty. In disease at the side of the neck, the knife must be employed freely, and, where possible, the sinus laid open to its termination. The same courageous use of the knife is called for in providing exit for pus burrowing amongst the muscles of the neck.

Infection may extend to the occipital bone and occipito-atloid ligament, causing arthritis and septic meningitis, with compression of the spinal cord. As a rule, treatment is not justified in cases of this kind, though, where the bone and ligament are alone involved, free removal of diseased tissue with the knife and curette, followed by continuous irrigation with an antiseptic solution may be tried. Nuclein, administered subcutaneously, has been recommended. It is said to limit extension of infection and arrest suppuration.

VI.—PHLEBITIS. INFLAMMATION OF THE JUGULAR VEIN.

IN former times, when bleeding was much more general, horses and cattle frequently exhibited this sequel of the operation. As a rule, the wound in the vein, caused by a clean lancet or fleam, closes by the edges coming together and uniting. Apposition is favoured by the negative blood pressure in the jugular, and usually no visible alteration is left in the vessel. The skin wound, if closed by pin suture, commonly heals by first intention. Occasionally, however, a small parietal thrombus forms at the point of puncture and results in slight thickening of the venous wall; or in other cases infection occurs producing phlebitis and obstructive thrombosis of the wounded vein.

Two forms of phlebitis—adhesive or simple and infective—are recognised. Probably they represent two degrees of a single inflammatory process, the difference being due to the greater or less intensity of infection. At the outset in both there is endophlebitis with thrombus formation, but in the simple form, the process, after a time, may terminate by adhesive cicatrisation and permanent obstruction of the vein; while in the other the thrombus breaks down, and the infective process rapidly involves the other coats of the vessel, producing ulceration, perforation and suppuration.

Jugular phlebitis is caused by infection contracted at the time of operation, or subsequently during the healing process; or it may arise from wounds or bruises of the neck involving the jugular groove. Certain accessory causes, which are not always avoidable, may be mentioned: the venous wound, if made with a blunt fleam or lancet, and not smoothly cut, but torn through, may be followed by phlebitis and coagulation of blood on the bruised surface. The same occurs when, owing to repeated use of the instrument, a double wound has been formed. Phlebitis may arise from any circumstance which prevents proper approximation of the edges of the venous wound; and from the formation of a clot between the skin and vein. Extensive extravasation at the point of bleeding may be produced by pressure of the collar on the unhealed wound, by animals leaning against the manger, by those with disease of the feet continuously lying, or by openings made into the vein for the introduction of drugs; in these cases infection takes place through the medium of the subcutaneous clot which extends to the vein. Phlebitis of the jugular seldom occurs without a wound of the vessel, though it must be allowed that inflammatory processes may extend

from without to the wall of the vein (periphlebitis). Such a case has been described by Peters.

Symptoms. On removing the pin a day or two after blood-letting, the skin wound, instead of being closed and dry, is swollen, and discharges a dark, blood-stained fluid. Within the next few days the œdema increases, and the vein is now found to consist of a round, firm fixed cord, extending a varying distance above and below the wound in the skin. The latter symptom proves the existence of a thrombus. The discharge may proceed from extravasation under the skin, and therefore, it is important to examine the vein. Filling of the vein on compressing the vessel at the base of the neck and collapse of the distension on removal of the pressure prove the non-existence of a thrombus. The use of a probe for diagnosis is not only superfluous but dangerous, because clotting and separation of emboli may thus be produced. The head, held stiffly, appears swollen at the throat, over the cheek, lips and nose of the affected side, the glosso-facial vein and roots of the jugular are distended (venous stasis), and mastication and deglutition may be difficult or suspended. Constitutional disturbance may be absent throughout the duration of a simple case, or there may be a fever temperature, with quickened pulse and respiration. These symptoms continue for four or five days in favourable cases (simple phlebitis), and as soon as the collateral circulation becomes adapted to the altered conditions, the facial œdema subsides and disappears, the cervical swelling diminishes except at the phlebotomy wound, the thrombus undergoes organization, but the vein remains obstructed, hard and resistant, and eventually is converted into a fibrous cord. Exceptionally, according to St. Cyr, a narrow tortuous channel is left in the vein, giving passage to a small stream of blood.

Should infection continue or extend (infective phlebitis), the thrombus undergoes purulent disintegration, the inflammatory process rapidly spreads to the other coats of the vessel, producing miliary abscesses with ulceration and perforation of the venous wall, and externally, centres of suppuration in the perivenous tissues. The infected vein is then transformed into a suppurating channel with lateral fistulous openings. The phlebotomy wound, granular and prominent, gives escape to a plentiful greyish foetid pus. Above this wound œdematous swelling extends to the head, concealing the parotid gland and filling the space between the rami of the jaw, while below the wound there may be little swelling or the œdema may descend to the chest. The patient suffers intensely, is highly

fevered, sweating and blowing. Moving the head from side to side, depressing it or moving the jaws, as in eating, is attended with pain, and in consequence the horse refuses to feed from the manger, though he may eat or drink from a pail held up to his head. He loses strength, and in less than a week will be found much emaciated and greatly reduced in condition. When thrombus formation rapidly extends towards the head, symptoms like those of "staggers" may appear, with loss of power in locomotion, inability to stand steadily, followed by gradual sinking from obstruction of the vascular outlets of the brain.

Complications. During the progress of infective jugular phlebitis, death may take place quite suddenly from profuse hæmorrhage from the vein. Rapidly increasing œdema of the throat or parotid region may cause roaring or intense dyspnoea, requiring, for its relief, the insertion of a tracheotomy tube. Systemic infection may occur, producing abscesses in various parts of the body, or occasionally embolic pneumonia, which is invariably fatal.

Prognosis. So far as the animal's life is concerned, simple phlebitis usually takes a favourable course. Although obstruction of the vein produces no lasting bad results, the animal cannot be worked during the active stages of the disease, nor can a horse with obliterated jugular usually be grazed, as from the pendant position of the head during feeding it swells owing to interference with the returning blood stream. Infective or suppurative phlebitis is always a grave condition, and sometimes results in death. Even where no serious complication supervenes, treatment must be continued until suppuration has ceased. Obturation or obliteration of the vein may occur in three or four weeks, but recurring suppuration over the diseased vein may continue for two or three months or longer.

Treatment. From prophylactic considerations it is desirable after blood-letting to rest the animal, and avoid any pressure on the vein, especially below the wound, hence for twenty-four hours the collar must not be worn. Moreover, everything likely to produce extravasation must be avoided, and the fleam or lancet never applied twice at the same spot. Where the wound has not closed after removal of the pin, it should be washed with sublimate or carbolic solution, to prevent decomposition of the extravasated blood. Once the vein is thrombosed, it cannot again be rendered patent, nor can further infection be prevented. Further mischief may sometimes be checked by repeated disinfection of the skin wound with the above-named or similar antiseptics. Should inflammatory

reaction or swelling become very marked, moist warmth will remove tension and pain, and infriiction with unguentum hydrargyri may be found useful. In applying the ointment severe pressure and rubbing must be avoided, lest the thrombus be broken up and emboli set free. Abscesses should be opened, and free exit given to discharge by increasing the size of the skin wound. In France a seton or a fenestrated rubber-tube is employed to drain the suppurating vein. A probe is introduced through the phlebotomy wound and directed upwards to within a short distance of the obstruction, where a counter-opening is made over the point of the probe. The rubber-tube is then attached to the probe and drawn into position. An antiseptic solution is injected into the tube at short intervals, and the drain is kept in position so long as suppuration continues. Under certain circumstances, as when severe bleeding occurs repeatedly, it may be advisable to ligature the vessel below, and if the thrombus does not extend too far upwards, it may also be ligatured above. The operation is performed according to general principles, the vessel divided between the points of ligation and removed. If it has been ligatured above the diseased point, the isolated section of the vein can be completely laid open. French surgeons often remove the disused portion of the vein, but in cases of suppuration Cadiot prefers free drainage. For some days after ligation the animal must be kept perfectly quiet, while, to avoid bleeding, only fluid nourishment should be given. Schley recommends washing out the vein with sublimate solution.

In removing the diseased portion of vein a ligature must first be applied above and below, taking care to apply the ligatures to healthy parts of the vessel. The vein is then divided transversely at the upper end, and completely separated from neighbouring structures. No danger results if the wound be treated as an open one, but care is required in exposing the vein to avoid injuring the carotid, and, therefore, the knife should be sparingly used, and the fingers or blunt scissors used in preference. Sometimes the vein tears cleanly away from surrounding tissues if moderate traction be exercised.

Several cases were successfully treated by laying open the sinuous wound and dressing with iodine solution, followed on subsequent days by carbolic or creolin lotions. (Cadiot and Dollar, "Clinical Veterinary Medicine and Surgery.")

VII.—DISEASES OF THE PHARYNX AND ŒSOPHAGUS.

(1.) FOREIGN BODIES IN THE PHARYNX AND ŒSOPHAGUS.

FOREIGN bodies in the pharynx are most frequently found in carnivora. Bones, fish spines, needles, pieces of wood, taken with the food, or picked up in play, sometimes stick in the pharynx. (See Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery," for reported cases.) In dogs and cats, sewing needles are often found at the base of the tongue close in front of the epiglottis. Pieces of potato or of other roots get lodged in the pharyngeal pouch of swine. In herbivora, pieces of wood, bones, hair-pins, and the like may become fixed in the mucous membrane of the pharynx, but more frequently lodge in the Œsophagus. In ruminants, especially in cattle, the offending substances are generally pieces of turnip, potato, fruit, beet, cabbage stalk, shoes, foetal membranes or cloth; in horses, carrots, chaff, linseed cake or hay; whilst occasionally the obstacle is a tooth, a hen's egg, a bolus, a portion of a prickly plant, or a piece of wood.

Grimm found a piece of a lamp chimney in the Œsophagus of a cow. Möbius found a thorn about 5 inches in length. Möller removed a whip handle about 3 feet long from a horse's Œsophagus. Drandrieux extracted a snake 10 inches in length from the gullet of a cow. Iwersen found a hair ball in the Œsophagus of an ox, eructated from the stomach.

Foreign bodies remain fixed either because they are sharp and penetrate the mucous membrane, or are too large to pass the narrow portion of the Œsophagus, or because the gullet has contracted on the obstruction. In horses, stoppage of the Œsophagus with hay results from swelling of the bronchial glands, from tumour formation, and from external compression. Cadiot and Dollar report a case of obstruction in a horse from swallowing a piece of carrot. A hypodermic injection of pilocarpine and eserine resulted in the foreign body passing onwards into the stomach in about three-quarters of an hour. In moribund animals, the food taken sometimes remains in the Œsophagus, and occludes long sections of it. Whether paralysis of the tube ever occurs is questionable. The portions of the Œsophagus where bodies are usually arrested are—

- (1) The commencement of the tube immediately behind the pharynx.
- (2) The lower portion in the neck.
- (3) The portion which passes through the diaphragm.

As obstruction produces different results in different kinds of

animals, it will be considered separately in each. The obstructing bodies are divisible into two classes :—(a) Wound-producing foreign bodies which pierce the mucous membrane, and remain in position in consequence of their rough surface ; and (b) mere mechanical obstructions which, on account of their size, are unable to pass through the tube. The first are most frequently found in the pharynx, the second in the œsophagus, though the first are also met with in the gullet.

According to Rubeli's experiments, the striped muscular fibres, which in man are confined to the first two-thirds of the œsophagus, are in animals continued almost to the stomach. In **ruminants** the œsophagus possesses no unstriped muscular tissue whatever. This first appears in the rumen. In all animals the mucous membrane is invested with a thick stratified epithelium, covered with numerous papillæ, and the mucosa possesses lymph follicles together with mucous glands. The area of the œsophageal tube stands in inverse proportion to the strength of its muscular coat. In the region of the cardiac opening a thickening or narrowing occurs in all domesticated animals with the exception of cattle and dogs.

The œsophagus of the **horse** is absolutely and relatively the longest, but also the narrowest. According to Franck, its length is from 49 to 65 inches. Rubeli found it to be from 50 to 52 inches, measured in position, and in larger animals even 56 to 70 inches. Its walls are strong, and become so much thicker between the diaphragm and the cardiac opening that the lumen of the tube almost entirely disappears, explaining the frequent occurrence in this region of diverticula, stenoses, and obstructions.

The œsophagus of **ruminants** and **carnivora** is more cylindrical. In oxen a contraction occurs at the lower end of the upper third, and from this point onwards the diameter increases, while the wall is comparatively thin, and decreases in strength from above downwards.

In **sheep** the thickness increases from below upwards, but the muscular wall is very thin in comparison with the surface of the mucous membrane. The narrowing at the middle of the œsophagus, remarked in the goat, is wanting in the sheep.

Swine have also a contraction at the middle of the tube, which from this point enlarges both above and below. In **dogs** the narrowest point lies at the height of the lower portion of the cricoid cartilage, the width being about $1\frac{3}{4}$ inches. The tube increases from here to a circumference of $2\frac{1}{4}$ inches, then narrows to 2 inches, dilates for a second time, and, about 6 inches behind the pharynx, attains a circumference of 3 inches. The last contraction, about $2\frac{3}{8}$ inches in front of the cardia, measures $2\frac{1}{4}$ inches. From here the œsophagus widens like a funnel, until it enters the stomach (the figures refer to the width of the mucous membrane).

In **cats** two contractions exist : the upper lies $\frac{3}{4}$ inch behind the pharynx, the lower at the point where the œsophagus pierces the diaphragm.

(a.) FOREIGN BODIES IN THE PHARYNX AND ŒSOPHAGUS OF THE HORSE.

In horses foreign bodies very seldom become fixed in the pharynx, but are more frequent in the œsophagus. As stated, they generally

consist of pieces of carrot, potatoes, hay, boluses, eggs, or grass. Greedy feeders supplied with soft hay are common sufferers. A considerable section of the Œsophagus is sometimes blocked, and the condition may recur at short intervals. Mollereau observed several recurrences within fourteen days. Graf found the Œsophagus filled with hay throughout. The thoracic portion, or lower cervical portion is usually the seat of the stoppage. Walther saw a horse whose gullet became occluded in consequence of its swallowing a safety pin which had perforated the Œsophagus transversely.

Symptoms. Animals cease feeding, slobber at the mouth, make choking movements, and stand with extended neck, and strained, anxious countenance. Any food or water taken is discharged from the nose. Not even the saliva can be swallowed, and in pharyngeal cases cough is often distressing. Considerable quantities of fodder accumulated in the thoracic gullet may press on the trachea and produce dyspnœa. Foreign bodies in the cervical gullet may be recognised by swelling, or detected by palpation. In the horse cervical choking is seldom dangerous, as the material generally softens, and passes downwards, and boluses and pieces of oil-cake, as well as hay and grass, may thus be removed without external assistance. The condition becomes graver, and horses may die, when such hard substances as eggs, boluses, etc., remain fixed in the thoracic portion, producing pressure on the trachea, and possibly suffocation, or mechanical pneumonia. Food and drink attempted to be taken are returned into the pharynx, and thence may enter the trachea.

Treatment must take cognisance of this danger. All food should be removed, but, after a time, a little water may be given to discover if the animal can swallow. Foreign bodies, fixed in the upper portion of the Œsophagus, may be removed by displacing them upwards into the pharynx with the fingers. Immelmann administered pilocarpine, which produced excessive salivation, lubricating both the obstruction and its surroundings, thus facilitating the former being swallowed. This remedy increases, however, the danger of mechanical pneumonia, and caution is required in employing it. The probang or Œsophageal sound can be used in quiet horses without casting them, but with greater difficulty and danger than in oxen. Walther dislodged a potato with it, but hay often presents considerable resistance, and injury may be done if force be used. It is, therefore, best to wait quietly for twenty-four to forty-eight hours, when the material generally passes downwards.

The usual Œsophageal sound for the horse is a solid whalebone rod, $\frac{3}{8}$ inch thick, and about seven feet long, with a conical expansion

at one end and a push-handle at the other. The base of the cone-shaped end is free and concave, and in order that it may pass without difficulty through the terminal portion of the gullet it should not exceed 2 inches in diameter. Tubular probangs for the treatment of gastric affections in horses have been devised by Sendrail, of Toulouse, and Phillips. Sendrail's probang, which has a spiral metal basis, is very flexible and can be easily sterilised. Phillips uses a long, stiff rubber tube resembling the stomach-tube for man.

In the horse the probang may be passed through the mouth, which is preferable or through the inferior nasal passage. When possible, the horse should be cast on his right side, the head and neck held fully extended, and a mouth-gag employed. The probang smeared with lard is introduced through the gag (the tongue being held), directed along the middle line of the roof of the mouth, against the soft palate, into the pharynx and gullet, then onwards to the obstruction, or, if necessary, into the stomach. Difficulty may be experienced at three points: the pharynx, entrance to the chest, and at the diaphragm. In passing through the pharynx the sound may excite coughing, or it may enter the larynx, when immediate reaction will be shown by the horse flexing the head and struggling. In this event, the sound should be withdrawn into the mouth, and after a brief interval passed again. In cervical choking, the probang soon reaches the obstruction, which may pass on without much effort; but in thoracic choking, resistance will be encountered as the probang enters the thoracic gullet, and when this curvature has been passed and the sound is in contact with the obstruction, the instrument must be carefully handled in order to avoid rupturing the gullet.

While it is possible in the horse standing to pass the sound through either the mouth or nose, the animal's head and neck cannot be maintained in full extension, and in consequence the probang is bent at the throat; and further risk arises in thoracic cases where the sound in entering the chest may lacerate the gullet. Unfortunately instrumental rupture of the œsophageal mucosa or muscle may give no immediate sign, and the operator may have no suspicion of the accident until later, when the horse shows distension of the gullet or symptoms of hindrance to the passage of food.

(b.) FOREIGN BODIES IN THE ŒSOPHAGUS OF CATTLE.

From the nature of their food, and the narrowing of the gullet from the pharynx to the lower part of the neck, choking is more

common in the ox than in the horse. Obstructions, as a rule, all occur close behind the pharynx, but are also tolerably frequent in the lower neck or thoracic portion. Death from suffocation sometimes results from cows attempting to swallow the after-birth, a portion of the membranes sticking in the œsophagus and pharynx, occluding the opening of the larynx, and so causing rapid suffocation.

Symptoms comprise restlessness, salivation, inability to swallow, attempts at eructation, difficult breathing, and tympanites. Part of the gas formed in the stomach is normally discharged through the œsophagus; but immediately the œsophagus is obstructed, this gas accumulates in the stomach and bowels, causing dangerous inflation. Increasing distension interferes with breathing, and may cause suffocation. These symptoms can be completely developed in a few hours, and hence it is necessary at once to carry out appropriate treatment. It is worthy of note, however, that Favereau, who has treated many cases, states that in the majority the obstruction will pass into the rumen and recovery will occur if the rumen be punctured and an expectant attitude be assumed thereafter. The cannula may even be left in position for several days.

Treatment may be by one of the following methods—

(1) **Return of the foreign body into the pharynx** is usually successful in root choking, where the obstruction remains fixed close behind the pharynx. The operator places himself on the left side of the animal passes his right arm over the neck, and with both hands (preferably with the thumbs) endeavours to push the obstructing body upwards by pressing in the œsophageal furrow. This usually succeeds if the animal's head be left free. But, if firmly held, the animal becomes disturbed, and stretches out its head, and even if the foreign body is forced into the pharynx its further outward passage is arrested. Where the first attempt fails, it can, however, be repeated, and, with a little dexterity, usually succeeds. In cattle, foreign bodies may be reached and removed from the pharynx or œsophagus by introducing the hand through the mouth. The head must be carefully fixed, and a mouth gag applied. The hand, protected with a glove, unprovided with fingers, is introduced rapidly and energetically, but it must not be kept too long in the pharynx, as pressure on the rima glottidis may produce struggling and dyspnœa. In the horse, the narrowness of the space between the rows of molars and the greater length of the soft palate render this procedure difficult, and it may not be successful unless the patient is cast, when the hand can easily be introduced and the pharynx explored.

(2) Reduction in size of the foreign body in situ may be

effected in the case of cooked roots when they lie in the neck portion of the œsophagus by powerful pressure with both hands. Pieces of oilcake, masses of hay, and boluses can sometimes be moved in this way, and caused to gravitate towards the stomach. Comminution of the obstruction may be effected by incising the skin over the foreign body and thrusting a fine trocar, grooved needle, or Syme's knife through the œsophageal wall into the obstructing body and breaking it down. It has been recommended to place a piece of wood against one side of the neck, and to break down the foreign body from the other side with a mallet, taking care not to injure the œsophagus or the trachea. This, however, is a very rough-and-ready procedure, deprecated by all British teachers.

(3) Forcing the foreign body onwards into the stomach. Where the above-described methods are unsuccessful, efforts should be made to pass the foreign body into the stomach. This must not be attempted with sharp or very resistant substances, but may be successful with bodies having smooth surfaces or of soft consistence, as, for instance, roots, oilcake, and hay. For this purpose the probang or œsophageal sound is used; failing this, a flexible cane may be selected, or a strong, well oiled rope may be employed. Although more easy and successful in oxen, Möller states that this procedure may also be used in horses even in the standing position. In cattle a mouth gag is applied, or a simple piece of wood with a hole

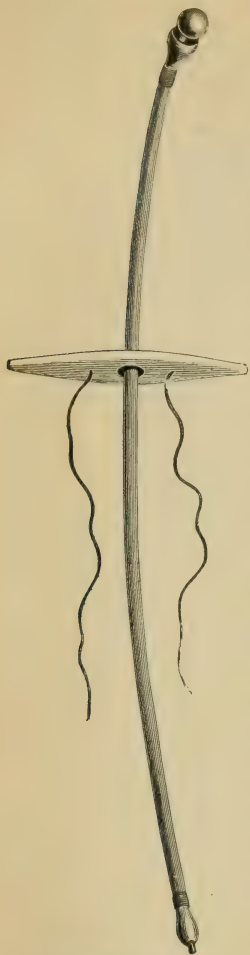


FIG. 342.—Probang and mouth gag for cattle.

in the centre may be used (Fig. 342). In the absence of a gag, the tongue is held by an assistant (best with the help of a cloth), and

drawn well towards one side. Two assistants, each grasping a horn and one end of the mouth gag, hold the head extended on the neck. The œsophageal sound is passed over the base of the tongue into the pharynx, and thence into the œsophagus. To avoid injury it must be introduced with caution. The only danger is that the instrument may pass into the larynx and trachea, but this accident is immediately evidenced by coughing and difficulty in breathing. Should it occur, the probang must be drawn back and the attempt repeated, until the instrument passes freely forward and can be felt at the left side of the neck in the œsophageal furrow—a proof that it has entered the œsophagus, down which it is slowly pushed until it reaches the foreign body, where further progress is resisted. Cautious attempts are made to push the obstacle onwards. These failing, the instrument is withdrawn, and an ounce or two of oil or a dose of pilocarpine may be administered; if relief does not follow within a short interval the probang may be tried again.

(4) **Extraction of foreign bodies by means of instruments.**

Amongst these is Meier's wire snare. It consists of a piece of brass or copper wire, about $\frac{1}{8}$ th of an inch in thickness, doubled and fastened by the ends to a handle, and works somewhat like the string snare, used for removing corks from the interior of bottles. It is introduced like the probang, the loop thrust behind the foreign body, which

may sometimes be extracted by turning and pulling on the instrument. But this device succeeds only where the obstruction lies in the upper portion of the tube, and is of such a character that it can thus be snared and held.

The methods already described, are, however, usually more successful, and the snare is therefore little used.

The so-called œsophageal screw, for transfixing pieces of potato or turnip, is not of much service. The œsophageal forceps constructed by Deltos and Hertwig are more useful (Fig. 345). They are introduced closed, but when the foreign body is felt, the jaws are opened by a screw,



FIG. 343.
Esophageal
screw.



FIG. 344.
(Esophageal
screw.



FIG. 345.—Deltos and Hertwig's œsophageal forceps.

the instrument advanced, and the substance grasped and removed. These appliances have, however, only a narrow field of usefulness. Although their working is often interfered with by the curvature of the Œsophagus at the entrance of the chest, notable especially in horses, one or other may be tried where the foreign body is low down and cannot otherwise be forced on. Dinter deprecates the forcible use of the Œsophageal sound, and when it is unsuccessful, punctures the rumen, and awaits the passage of the foreign body, which almost invariably occurs in six to eight hours. Strebel confirms this, but in one case had to wait forty-eight hours for the passage of the obstruction. He also suggests giving small doses of oil. Willach also recommends this expectant treatment. The subcutaneous breaking down of the foreign body, suggested by Lafosse, is liable to injure the jugular, and is usually followed by pus formation, necessitating enlargement of the wound. Mauri has, nevertheless, recommended this treatment recently. Should difficulties occur in removing the foreign body, and considerable tympanites result, as is frequent in cattle, the rumen must be punctured to ward off suffocation.

If the removal of the offending substance by the described methods fails, as is usually the case when it lies in the thoracic portion, drenching with small doses of oil may be tried, if no difficulty in breathing exist. Caution, however, is necessary to prevent the fluid passing into the trachea and producing mechanical pneumonia. Small quantities should be given at a time and the animal watched, so that, if coughing occur, the administration may at once be stopped. After puncture of the rumen, it is desirable to wait for twelve to twenty-four hours for softening and dispersal of the foreign body. Michalski gave a bull $1\frac{1}{2}$ grains of veratrine dissolved in $2\frac{1}{2}$ drams of spirit subcutaneously, producing violent Œsophageal spasms in fifteen minutes and the disappearance of the obstruction. Immelmann's statements point to the possible usefulness of subcutaneous injections of pilocarpine, which provoke profuse salivation. Apomorphine favours Œsophageal peristalsis and eructation, although this latter act is only produced exceptionally. Arecolin and eserin given hypodermically and chloride of barium intravenously have also been recommended.

(5) **Œsophagotomy.** Incision into the Œsophagus. This operation can only be performed in the neck portion of the Œsophagus, and is only indicated where the measures above described fail. It is the last possible resource, where one has to deal with sharp substances, like bones, &c. Its difficulties and dangers are usually

exaggerated; it is not dangerous to life, and is only occasionally followed by bad results, though some degree of stricture must be expected. Quiet animals, such as cattle, may be operated on in the erect position. After clipping the hair from the left side of the

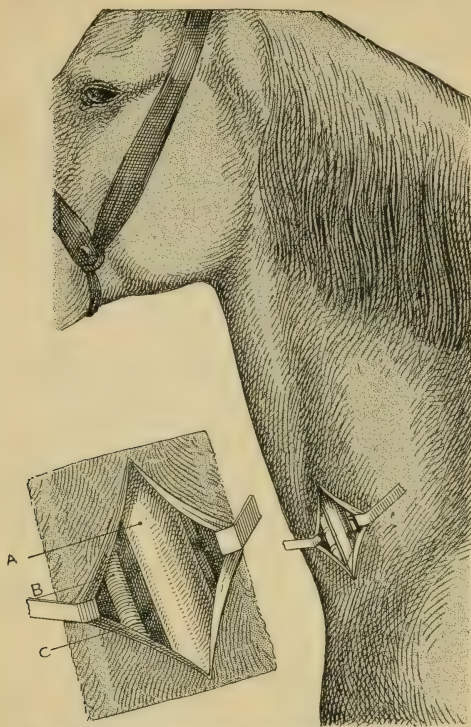


FIG. 346.—To illustrate the operation of œsophagotomy.

A, œsophagus; B, carotid artery; C, trachea. (Semi-schematic.)

neck, over the foreign body, and farther below than above this, an incision is made through the skin, about 4 inches in length, on the anterior or under border of the jugular vein, and parallel with it. After dividing the fascia and subscapulo-hyoideus muscle, the loose connective tissue encountered must be torn through by means of the two forefingers. The carotid is first sought, and will be immediately recognised by its pulsation. The finger is then passed forward in the direction of the posterior aspect of the trachea, where the

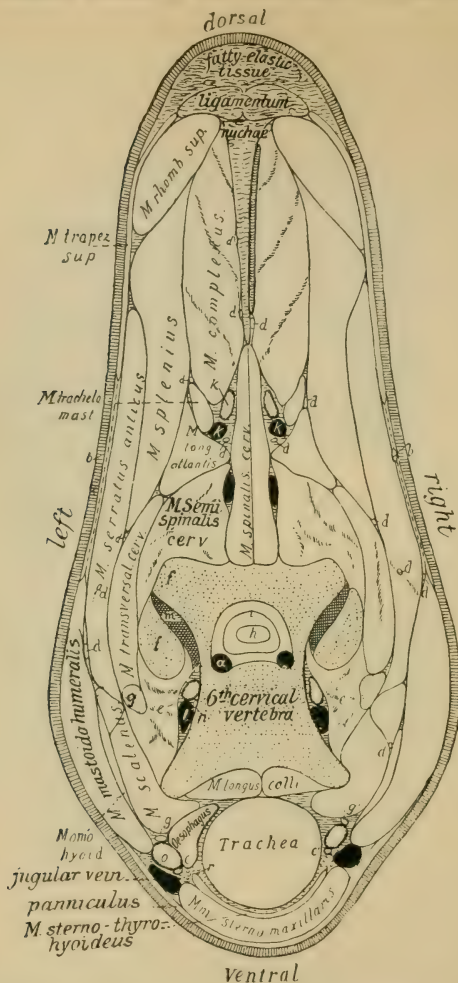


FIG. 347.—Section at right angles to the long axis of the neck through the upper third of the 6th cervical vertebra.

a, Veins of spinal cord; *b*, branch of spinal accessory nerve; *c*, recurrent nerve; *d*, inconstant nerve twigs; *e*, intertransversales muscles; *f*/*g*, portions of vertebra; *h*, spinal cord; *i*, its membranes; *k* *k'*, superior cervical artery and vein; *l*/*l'*, vertebral artery and vein; *n*, branch of the sympathetic; *o*, carotid artery; *p*, jugular vein; *q* *q*, vagus and sympathetic nerves; *r*, tracheal lymphatic gland.

œsophagus can easily be found, especially if a foreign body is fixed in it. It is drawn forward, and its two coats divided as far as seems necessary for removal of the foreign body.

As Dette has correctly remarked, it is desirable to make the incision in the skin under the jugular vein, and not over it, as is often described, in order that wound discharges and any portions of food may flow away as easily as possible. Further, the operation wound should not be larger than is absolutely necessary; whilst the œsophagus should be separated as little as possible from its surroundings. Under certain circumstances the potato or root may be broken down within the œsophagus and the pieces passed onwards, or removed through a smaller wound. The wound of the gullet must be sutured, preferably with chromic catgut, first bringing the mucous membrane together, and then the muscular coat. The overlying wound need not be sutured, as healing by primary intention cannot be expected. The wound is treated on general principles. For the first twenty-four hours food and drink must be completely withheld, though, if deemed necessary, pure water may be given. During the next few days soft food or hay may be supplied. Tainturier gives nothing but hay and pure water to cattle, and in one case obtained healing in thirty-five, and in another in twenty-five days. Malzew performed œsophagotomy five times in oxen and six in dogs; healing occurred within eighteen to twenty-three days in the oxen, and in twelve to eighteen in the dogs. Although the animals fall away in condition, bad consequences are rarely observed.

(c.) FOREIGN BODIES IN THE ŒSOPHAGUS OF SWINE.

When housed, swine are usually fed on boiled roots, carefully cut potatoes, or semi-fluid gruels, so that food rarely causes obstruction. But when roaming in herds, and fed on uncut potatoes or other roots, pieces may stick in the pharyngeal pouch or in the œsophagus, and provoke symptoms similar to those in other animals. According to Lothes, foreign bodies in the pharyngeal pouch of swine produce difficulty in swallowing, salivation, and a peculiar change in the voice; instead of grunting, a shrill shrieking sound is produced, and if the subjects are in poor condition, the obstruction may be detected by palpation. Foreign bodies fixed in the œsophagus sometimes induce vomiting, and are thus ejected; but where long retained, tympanites develops, and death ensues from suffocation.

Early assistance is necessary, but in pigs little can be done

manually. If the obstruction is in the pharyngeal pouch, pressure must be exercised simultaneously on both sides directly over the region of the larynx, and an effort made to push the contents of the pouch upwards into the pharynx. Where the foreign body is fixed in the top of the pharynx or just beyond it, Stockfleth advises that the pig be laid on a table, when removal may sometimes be made with a blunt hook, but if the object is deeper seated it may be pushed downwards with a flexible stick. Teetz removed a piece of broom-stick $12\frac{1}{2}$ inches long from the upper part of a pig's œsophagus. Apomorphine can be tried as an emetic; if this does not at once succeed, fat pigs had better be slaughtered. Œsophagotomy may be performed in those in poor condition; it is scarcely more difficult or dangerous than in other animals. Hering reports two successful cases; the wound healed without being sutured. Sometimes fistula results from this operation.

(d.) FOREIGN BODIES IN THE PHARYNX AND ŒSOPHAGUS OF CARNIVORA.

Reference has already been made to the occurrence and treatment of foreign bodies in the mouth of dogs and cats. They occur usually at the base of the tongue, often close under the epiglottis, though sometimes behind the soft palate in the posterior wall or in the sides of the pharynx. Removal must be effected according to the directions before given. Bones, particularly vertebræ of birds and game, fish-bones, needles, and other sharp objects, are liable to get fixed immediately behind the pharynx and occasionally in the thoracic portion of the gullet or just before it enters the stomach. Smooth rounded objects are seldom found obstructing the œsophagus in these animals; they generally pass onwards to the stomach. Reichenbach removed from a dog's œsophagus by incision a piece of wood $4\frac{1}{2}$ inches long, $\frac{5}{8}$ of an inch broad, and $\frac{1}{2}$ an inch thick. Restlessness, anxiety, retching and vomiting, avoidance of food and drink, and most notably discharge of ropy saliva, suggest the presence of a foreign body. Pressure on the œsophagus sometimes gives pain.

Sharp substances perforating the œsophagus in the neck portion cause swelling and inflammation, in the thoracic portion, rapidly fatal pleurisy. They can occasionally be successfully extracted by way of the pharynx, as described in the chapter "Foreign Bodies in the Mouth." The foreign body, when in the lower portion of the

œsophagus, may be pushed onwards with an expanding œsophageal sound or a flexible catheter. This failing, emetics, such as apomorphine subcutaneously, may be tried, and, if unsuccessful, œsophagotomy which in dogs as in other animals is without danger, must be performed. Möller often operated successfully. In one case the œsophagus was perforated at two points, but the piece of bone was removed, and healing followed without stricture or other bad result.

Coleman removed a rabbit's vertebra from the œsophagus of a dog by incision. Complete healing in a fortnight. Porcher and Morey state having discovered by Röntgen photography the presence of a coffee spoon in the last portion of a dog's œsophagus and having removed it by gastrotomy. Healing by primary intention.

(e.) IMPACTION OF THE CROP IN BIRDS.

The crop is a diverticulum of the œsophagus, in which the food is prepared for digestion as in the first compartments of the ruminant's stomach. Impaction results from excessive distension with dry foods, or with indigestible foreign bodies, and from compression of the œsophagus in disease of the lungs.

Symptoms comprise excessive fullness or distension of the crop, which feels hard and firm, want of appetite, and sometimes discharge of offensive fluid from the beak, which is usually held open. If the condition persists for long or frequently recurs, the crop becomes greatly dilated, the animals gradually waste, and may die. The condition is seen in fowls, ducks, geese, and pigeons and by recurrence becomes chronic.

Treatment consists in massage. Attempts should be made to empty the crop or to break down the hardened contents by pressure and kneading. Zürn recommends hydrochloric acid. If this proves useless, as in distension with foreign bodies like sand and stones, the crop must be emptied by operation, which is well sustained by most birds. After removing the feathers, the crop is divided in the long direction of the neck far enough to allow of the finger entering and the contents being withdrawn. The wound is cleansed and sutured, and generally heals by first intention. According to Zürn pigeons are not good subjects for operation, especially during breeding, the mucous membrane of the crop being swollen and very rich in blood-vessels.

(2.) INJURIES TO THE PHARYNX AND ŒSOPHAGUS (ŒSOPHAGEAL FISTULA).

Injuries to the walls of the pharynx occur in all animals, but most commonly in horses. When rasping the teeth the chisel or rasp, if carelessly handled, may severely injure the pharyngeal wall, and even produce death from bleeding or acute inflammatory processes. Like injuries result from the use of sticks in giving balls; from awkward employment of pharyngeal sounds, forceps, and other instruments; and in all animals, and notably in carnivora, from sharp foreign bodies. Merkl found a hairpin in a horse's pharynx. Injuries to the œsophagus are almost invariably caused by sharp foreign bodies, or by œsophageal instruments used for their removal. Injuries from without are uncommon, though Graf and Braun have both seen injuries to the œsophagus in horses caused by kicks from other animals.

The course of such injuries depends entirely upon their character. As already stated, fatal bleeding may occur, or suffocation from passage of blood into the trachea. Where the inflammatory process is superficial, and foreign bodies have been promptly removed, healing often occurs quickly; but deep-seated inflammation with œdema of the mucous membrane of the pharynx and adjacent parts may supervene, threatening suffocation. Foreign bodies injuring the mucous membrane of these regions sometimes produce extensive inflammation and the formation of abscesses, which may break externally and cause œsophageal fistula, or into the thorax or abdomen, inducing septic pleuritis or peritonitis, and rapidly leading to death. Laser records, in a remount horse, the rare case of double rupture of the œsophagus—one in the neck portion, the second in the thorax; death ensued. External perforation is most frequently met with at the upper end of the œsophagus, close to the pharynx; Möller has several times seen this in horses. The abscess breaks and discharges an exceedingly offensive pus, often mixed with food, after which saliva, food, and water escape during swallowing, proving beyond question that the disease has originated in the œsophagus or pharynx. The wound closes gradually but a small fistulous canal remains, discharging water and saliva, and healing often with the greatest difficulty. This constitutes œsophageal or pharyngeal fistula. Butters recently described such a case. The inflammatory process and consequent swelling produce difficulty in swallowing, and not infrequently febrile symptoms. A swelling develops on the left side, gradually increases, becomes soft, and

finally breaks, when the difficulty in swallowing and the fever disappear. Guilmot saw a case of abscess formation in the lumen of the œsophagus of a calf, causing vomiting, tympanites, and difficulty in swallowing; on introducing the œsophageal sound, about two pints of pus were discharged, the symptoms disappearing some days later. Hanbold saw an œsophageal fistula produced in the horse by abscess formation in the retro-pharyngeal lymph glands; the animal recovered in three weeks. Stamm had a similar case following strangles. Fistula of the gullet sometimes results from œsophagotomy. Injuries to the walls of the pharynx by balling-guns or tooth instruments, indicated by salivation and disturbance in swallowing, may heal, provided they do not become complicated by infection, bleeding or inflammation. In small animals their position and extent can be determined by direct inspection.

Treatment. As already indicated, care must be exercised in the use of œsophageal and tooth instruments, and sharp balling-guns or sticks avoided. The duration of pus formation in the throat may be shortened by early and cautious opening of the abscess, by careful disinfection and by making provision for free escape of wound discharge. Œsophageal fistula sometimes gives much trouble. Definite closure may often be produced by applying the actual cautery, but is not always successful. In a horse under Möller's treatment cauterization and other measures were used without result. Enlarging the fistula and suturing the opening in the œsophagus generally produces healing, though the operation is by no means easy, and does not in every case produce the desired effect. In Butters' case injections of nitrate of silver proved useless, but the fistula closed spontaneously in four months.

(3.) ECTASIÆ, DIVERTICULA, AND RUPTURES OF THE ŒSOPHAGUS.

The term ectasia is applied where the skin, muscular and mucous tissues have undergone dilatation. Ectasiæ sometimes result from stricture of the œsophagus, and, like it, usually develop slowly. They occur both in large animals and in carnivora.

Langrehr saw a cow which for three months had always vomited after taking food, and especially when drink was given soon after feeding. The cow was very thin, and when slaughtered exhibited a dilatation of the œsophagus close under the diaphragm, and capable of holding nearly three quarts of fluid. Wagner examined a horse which had a dilatation of the œsophagus in front of the fourth cervical vertebra, and also just

before its passage through the diaphragm. The condition had led to an attack of mechanical pneumonia and death.

Sometimes dilatations take a spindle form, sometimes they are sharply defined. Where greatly developed, difficulty in swallowing occurs, and wasting afterwards sets in.

Diverticula are here taken to mean ruptures of the muscular coat of the œsophagus, and passage of the lax but unruptured mucosa through the opening. This has been described as œsophagocele, and is oftenest met with in horses and cattle. It sometimes results from accident in passing the œsophageal sound or probang, or it may follow greedy consumption of rough and prickly clover. Such ruptures occur in the neck portion of the tube, frequently close to its entrance into the chest, and occasionally near its termination.

Both the muscular and mucous coats may become ruptured at the same time, or the mucous coat may yield somewhat later than the muscular.

Fuchs discovered a dilatation of the œsophagus after death, where the neck portion had a circumference of $9\frac{1}{2}$ inches, the thoracic portion of $12\frac{3}{4}$ inches, and the portion in front of the diaphragm was distended to $20\frac{1}{2}$ inches. Dr. S. describes a diverticulum in the horse formed in consequence of the muscular coat being ruptured for a distance of 11 inches in the thorax. The sac-like dilatation held five pints of water, and the horse suffered from symptoms of broken wind. Schellenberg saw a similar diverticulum in the dog, produced by a bite and subsequent abscess formation. On post-mortem, six months later, a diverticulum was discovered as large as a man's fist. It had resulted from cicatricial contraction.

Of twenty-six cases collected by Rubeli, the diverticulum was, in eleven, close to the diaphragm, in seven in the thoracic portion, and in eight in the neck portion, usually in the lower part of it. The anatomical disposition of the œsophagus in horses explains this distribution. Illustrations of these several classes of cases are recorded.

Ruland relates that a horse which had suffered from colic, with severe attacks of vomiting, was found to have the œsophagus ruptured close in front of its passage through the diaphragm. Leisering describes a diverticulum in a horse which died from suffocation: 3 feet from the pharynx the distended œsophagus has a circumference of about 16 inches, 8 inches lower the circumference was 12 inches, $13\frac{3}{4}$ inches higher it measured $12\frac{1}{2}$ inches; close in front of the cardiac opening was a second diverticulum. Grünwald saw a horse which died a day after suffering from a shivering and "blowing" attack. The post-mortem discovered a quantity of turbid fluid mixed with food in the thorax. The œsophagus was ruptured for $4\frac{1}{2}$ inches close in front of the diaphragm, and in front of this again was dilated for a distance of 16 inches, its walls being more than $\frac{1}{2}$ inch thick, and its circumference 6 inches. At the point of rupture the mucous

membrane formed a cavity as large as a hen's egg. This communicated with the rupture. Grünwald considered that an abscess had formed in the œsophageal wall and caused the rupture. But it also seems possible that the condition was a simple diverticulum. Harms, Hartenstein, and Roloff describe cases of œsophageal diverticula in cows; one detailed by Harms was situated $2\frac{3}{4}$ inches in front of the rumen.

The symptoms of these conditions bear a general resemblance to one another. Ectasiæ and diverticula are recognised by symptoms of choking and a tendency to vomiting, usually appearing soon after taking food. Where the lesion is in the neck portion of the œsophagus, a swelling appears on the left side of the neck during feeding, which is not painful, or only slightly so, shows no inflammatory symptoms, but may be accompanied by salivation, choking, or attempts at vomiting, and usually disappears after one to two hours. Pressure on it produces symptoms of suffocation and attempts at vomiting. It is commonly more prominent after consumption of dry chaff than after hay or water. It may continue for a long time without impairing general health, but when large, especially if situated in the thoracic portion, or when distended with food, such swellings not only excite choking and vomiting but compress the trachea and produce dyspnœa. The horse described by Leisering, if smartly exercised, especially after feeding with hay, exhibited dyspnœa and coughing, which disappeared later. The animal eventually died from suffocation. Other cases have been described. The symptoms may continue for a long time without causing more than loss of condition and slowness in feeding, though the dyspnœa sometimes produces death, as shown by the cases reported by Leisering, Fuchs, and others. Finally, obstruction may lead to mechanical pneumonia and death in consequence of interference with swallowing, as in Wagner's case.

In complete rupture of the œsophagus symptoms are produced similar to those of severe injury to the œsophagus. If in the cervical portion, they comprise emphysema in the neck and formation of abscesses, which by-and-by perforate and discharge pus mixed with food. These may heal like œsophageal wounds. Spontaneous healing in a cow is related by Schleg; but death may ensue from burrowing of pus and general infection, as Laurent's and Graf's observations show. Graf's case was caused by a kick from another horse. Schleg's case in a cow shows that spontaneous recovery is nevertheless possible. Krebs records dilatation and rupture of the œsophagus in a horse in consequence of fatty degeneration of the muscular coat.

Should the œsophagus become ruptured in the thorax or abdomen, death soon follows from septic pleuritis or peritonitis. Kehm and Grünwald report such cases in the horse. Accumulation of food

may cause inflammation and destruction of the mucous membrane, especially during the earlier stages and before it becomes gradually thickened and more resistant.

Prognosis in these cases is usually unfavourable. If ectasia does not endanger life, it seriously interferes with nutrition and the use of the animal, and is usually incurable. By regulating the diet it may be possible to keep the animals at work ; fat cattle should be prepared for slaughter.

Treatment. In ectasiæ, particularly when extensive, therapeutic treatment scarcely promises any good result, but in diverticula in the cervical portion of the Œsophagus something may be done, both in horses and cattle, by operation, as is shown by the cases related by Reinemann, Schwerdtfeger, Moisant, Reichel, and others. The dilated portion of the mucosa may be replaced or excised, and the rupture in the muscle brought together by sutures. With antiseptic precautions, the operation is not attended with much danger. This is the most promising treatment in animals, but in chronic cases is more easily described than carried out, especially if the rupture in the muscular coat is already cicatrised and fixed to the neighbouring parts by much cicatricial tissue. The operation can, however, be tried.

Procedure is similar to that of incising the Œsophagus. After returning the mucosa, the muscular coat is, where practicable, carefully sutured with catgut or silk stitches inserted close together ; bad results naturally follow if the stitches tear out. Where this course is impossible, the diverticulum must be opened, a piece of the dilated mucous membrane excised, and the parts brought together in the above fashion. Moisant applied a sort of clamp during eating and drinking, and obtained good results in a horse, and afterwards in two cows. Careful stitching of the muscular and mucous coats is, however, not only simpler, but equally successful. Reinemann effected a cure, although the stitches tore out in two days, owing to inappropriate feeding. Granulations gradually close the opening. Reichel operated on oxen in the standing position. To prevent the stitches tearing out, nothing more than water should be given during the ensuing twenty-four hours, and during the next few days only fluid nourishment. In complete rupture of the cervical portion of the Œsophagus, the same treatment is recommended as in injuries from sharp substances. Nothing can be done in ruptures of the thoracic and abdominal portions.

(4.) STENOSIS AND COMPRESSION OF THE ŒSOPHAGUS.

Stenosis of the œsophagus may be congenital or it may result from chronic inflammation of its wall. Stricture or cicatricial stenosis is usually accompanied by dilatation. Andersen relates that a horse had for four months repeatedly suffered from impaction of the œsophagus, and on post-mortem showed a ring-like contraction, about 8 inches below the pharynx; the portion above this point was widened (ectastic). Köhne describes as stricture what appears to have been a diverticulum.

A similar case is described by Friedenreich; a horse, after suffering for a long time from difficulty in swallowing, finally died from hunger, and on post-mortem a duplication of the mucous membrane was discovered arising from the upper pharyngeal wall, reducing to one-third the dimensions of the pharynx. The mucous membrane did not appear diseased.

Compression of the œsophagus is caused by tumours in the thorax, or by swelling of the bronchial lymphatic glands (compression stenosis). Johne and others report such cases in oxen, in which tuberculous bronchial glands compressed the œsophagus, and caused difficulty in swallowing and disturbance of nutrition. Animals are less frequently affected than men by contraction of the mucous membrane, the swallowing of irritants, or by narrowing of the lumen of the tube by tumours or parasites like *spiroptera sanguinolenta*, constituting obturation stenosis. These conditions can seldom be diagnosed with certainty. Their chronic course distinguishes them from the disturbances produced by foreign bodies or by diverticula of the œsophagus. Cattle often show chronic tympanites, and where this is accompanied by coughing and wasting, suspicion of tuberculosis must arise.

There is seldom opportunity for treatment, the condition in most cases being only definitely recognised on post-mortem examination.

(5.) PARALYSIS OF THE PHARYNX AND ŒSOPHAGUS.

The muscles of the pharynx and the upper two-thirds of the œsophagus receive their motor supply from the 9th and 10th cranial nerves, the last third of the œsophagus being supplied by the vagus. Paralysis of these nerves may induce functional disturbance. Records are numerous of so-called paralysis of the œsophagus, but the descriptions are not always reliable or complete, and some of the cases depend not so much on paralysis as on structural changes or

the presence of foreign bodies. No strict distinction can be made between paralysis of the pharynx and œsophagus. Conditions viewed as paralysis of the œsophagus must sometimes be referred to the pharynx. In serious diseases, especially in brain disorders and rabies, as well as towards the end of life, innervation of deglutition often suffers, and food consequently remains fixed in the œsophagus. Hence post-mortem examination of horses often discovers accumulation of food in the œsophagus, without any apparent obstruction in the lumen of the tube; but these cases have no further clinical interest.

Möller treated a horse which showed difficulty in swallowing for a long time; no cause could be discovered, no other morbid symptoms were present— even on post-mortem nothing abnormal could be detected. In another horse, recovery from a laryngeal injury was followed by difficulty in swallowing, and though food was chewed as usual, no attempt was made to swallow it, but the horse allowed it to fall from the mouth again. The tongue appeared normal, both in appearance and function. It, therefore, seems probable that paralysis of the pharynx existed, though the strict proof was wanting. We have seen similar difficulty in deglutition several times after resection of the arytenoid cartilage; in one case caused by great increase in the connective tissue about the larynx and pharynx; in another case the symptoms completely disappeared after some weeks. Possibly this case depended on inflammatory swelling in the pharynx, though the animal showed no other disturbance. Dieckerhoff saw a similar case in a horse. That inability to swallow may be caused by impaction of the œsophagus appears evident from Puschmann's record of a horse which had the tube packed tightly with hay two inches from the cardiac orifice. The cases described by Cadéac and others as œsophageal cramp may probably be referred either to impaction of the œsophagus or other hindrance to the passage of food (diverticulum, stenosis). Complete blocking of the œsophagus naturally prevents the possibility of swallowing. This is easily explained if one adopts Kronecker and Meltzer's view, that food is injected immediately into the stomach from the pharynx.

Köhne saw six otherwise healthy horses which appeared unable to swallow, and in consequence very rapidly fell away in condition; they showed some œdema under the chest. The autopsy revealed nothing of a positive character.

Stietenroth saw some similar cases; the pupils of the eyes were markedly dilated, and at a later stage there was loss of sensation over almost the whole surface of the body, a condition which Stietenroth interpreted as pointing to belladonna poisoning. This view seemed to be supported by the fact that the disease attacked two horses in the same stable within a short interval.

Schmidt has indicated the possible occurrence of one-sided paralysis of the pharynx and œsophagus. An old mare had a left-sided nasal discharge; the left nostril was filled with food, and on drinking a great part of the water flowed back through the nose.

She soon died, and examination showed the left superior maxillary sinus filled with food, mechanical pneumonia existed, and the left half of the soft palate was atrophied ("only rudiments existed"), while the wall of the pharynx on the left side was dilated in a pouch-like form. Pharyngeal paralysis was also seen in an army horse, but disappeared after eight days' treatment with strychnine.

Reports as to inability to swallow appear enigmatical. The horses can take food, chew, and swallow in the usual way, but are unable to make drinking movements. They go greedily towards the water, make snapping movements with the lips, and move the tongue without being able to take a single swallow of water. Friedberger and Fröhner believed that a congenital defect existed in the nervous centre (sucking centre). But it is remarkable that the animals under these circumstances had lived so long, the one mentioned by Friedberger being eight years old.

Symptoms. Inability to swallow, especially if associated with stoppage of the Œsophagus with food, reveals the nature of the case. It is often noted in rabid dogs that the animals attempt to drink, but that little or none is swallowed. It is difficult to determine whether the inability to swallow depends alone on the masticatory muscle paralysis or in part on paralysis of the pharynx.

Treatment. It is of primary importance to attempt the removal of the frequently existing obstruction in the Œsophagus, and for this end the probang is most useful. Appropriate diet must also be given. Drugs are of little use, though strychnine might be tried. It is more hopeful to treat the general conditions to which the disease is sometimes due.

(6.) TUMOURS IN THE PHARYNX AND ŒSOPHAGUS.

Such tumours are more common in cattle than in other animals. New growths in this region have long been recognised; their gravity depends upon their nature. Roloff considered them to be retention tumours, arising from the mucous glands of the pharynx. Harms declared them to be lymphomata, but the conviction has gained ground that they are usually cases of actinomycosis. They generally develop singly on the posterior upper wall of the pharynx, under the sphenoid bone, or close above and behind the larynx. Harms named the former, which usually attain the size of an apple, "anterior," the latter, which are commonly much larger, "posterior pharyngeal actinomycomata." Considering their frequency in cattle, infection is doubtless often produced by food containing actinomycetes. The comparatively thin, tender mucous membrane injured by the passage

of hard sharp forage is easily infected. As the growths enlarge, the following **symptoms** appear :—

(1) **Dyspnœa.** The respiration is snoring and rattling, attended with cough, and the dyspnœa occurs particularly during feeding, and sometimes at every effort to swallow. When the head is bent, this disturbance is more marked, a circumstance valuable in diagnosis. (2) **Difficulty in swallowing.** The tumour, as it becomes larger, interferes with deglutition. The head is extended, and food entering the pharynx excites coughing. (3) **Palpation** from without sometimes discovers swelling in the region of the pharynx. In making this examination, the head must be extended as much as possible, and the two hands pushed upwards above the larynx. Harms once found dislocation of the larynx. On introducing the hand into the pharynx, the condition, size, character, and position of the new growth can be fully determined.

This examination is necessary to differentiate the condition in question from diseases of the tongue, or from swelling of the retropharyngeal lymph glands, though the latter is not very frequent in oxen. Nevertheless, it has been several times observed, and Prietsch describes a case. A well-nourished cow gradually developed snoring respiration four to five months after the first calving. It was most marked when eating hay, and sometimes became so severe that chewing was interrupted, the head extended, and the tongue thrust out of the mouth. The larynx was swollen and enlarged. Post-mortem showed tuberculous changes in the lungs and retropharyngeal lymph glands.

According to Harms, the anterior pharyngeal swellings contain a greyish-red material, sometimes calcified, in the interior of which actinomyces can be detected. The posterior have a smooth fibrous form, and contain a greenish decomposed material. They develop slowly. Harms states that the swelling may exist for five months or more without producing danger of suffocation, but the symptoms, and especially the respiratory disturbance, generally increase. He further remarks that in the posterior pharyngeal swellings arrest of growth may occur, so that clinical symptoms remain stationary.

Prognosis is unfavourable; complete recovery improbable, although improvement may be secured for a long time by operative treatment.

Treatment. Harms casts the animal, raises the neck, and makes a longitudinal incision in the middle line under the larynx, through which the hand is introduced, the connective tissue at the side of the larynx is then divided, the tumour reached and removed by breaking down the tissues around it. Meier casts the animal on the right side, inserts a mouth gag, raises the head, introduces the right hand into the mouth and pharynx with its volar surface towards the palate, and grasps and tears off the anterior actinomycotic

growths. The posterior growths, on account of their firm coating of connective tissue, cannot thus be dealt with, and, therefore, Meier pierces these with the finger, allowing the contents to escape. Harms prefers the former of these methods, and of the latter remarks that it is difficult to carry out, and does not always remove the dyspnœa.



FIG. 348.—A papilloma from the œsophagus of an ox. (After Kitt.) (The œsophagus is everted and dilated by the insertion of a wooden rod.)

Esser, after extensive experience, has come to the conclusion that the operation seldom produces lasting good results. Iodide of potassium may be tried.

Excepting polypi, tumours in the pharynx of **horses** are rare, and little is at present known as to their nature. The symptoms resemble those in oxen, and the methods for removal are similar; but it is not always possible to introduce the hand into the pharynx. Degive, on making

the post-mortem of a horse which had repeatedly suffered from sudden attacks of dyspnœa, threatening death from suffocation, observed a cystoid tumour as large as a hen's egg on the floor of the pharynx close in front of the epiglottis. Labat operated on a horse which had suffered from nasal bleeding and difficulty in breathing and swallowing. By opening the larynx, and dividing the soft palate, he succeeded in removing a tumour from above the larynx by the *écraseur*. The growth proved to be an epithelioma (compare with next chapter as to occurrence of laryngeal tumours).

Such tumours are rare in **carnivora**. Diericx removed from the pharynx of a dog, with the help of a snare, a double polypus 2 inches long, which on microscopical examination proved to be a fibroma. In spite of extended practice, Möller has not yet seen similar disease in dogs.

Tumours of the œsophagus are most frequent in **ruminants**, especially in cattle, and may be due either to actinomyces (Siedamgrotzky, De Jong) or be simple papillomata (Schütz). The former are usually single, the latter multiple. Fessler describes a case of multiple papilloma in the œsophagus of an ox. The entire surface of the œsophageal mucous membrane was covered with warty brush-like outgrowths, which were only the size of a grain of barley in the neighbourhood of the pharynx, but became as large as a bean in the middle of the œsophagus, and formed bristle-like tufts. Lower down they were not so numerous. These papillomata resembled bunches of bristles, numbering thirty or more, which grew from a conical base in the form of a brush. Microscopical examination showed the following appearances:—The *propria mucosa*, below the papilloma, contained spherical masses of blood-vessels, in which the veins formed large cavernous spaces. The papilloma was provided with a solid root containing loops of blood-vessels from which processes of connective tissue extended into the threads and bristles. The connective tissue was covered with epithelium.

Beel noticed a case of multiple papilloma in the œsophagus of an ox, marked by difficulty in deglutition, swelling on the left side of the neck, difficulty in introducing the probang, chronic tympanites, and reduced condition. Post-mortem showed "intra-œsophageal stenosis," with dilatation above the contracted spot. The latter, which was of uniform width, began below the pharynx, was $6\frac{3}{4}$ inches in length, and ended at the height of the second rib; its greatest circumference was $9\frac{1}{2}$ inches, the thickness of the muscular coat $\frac{1}{8}$ inch. The mucous membrane was covered with a great number of wart-like papillæ of varying size, some not exceeding that of a pin's head, others as large as a hazel nut; forty-five of them were from 1 inch to $1\frac{1}{4}$ inches long; it was contracted at the level of the second rib, but still allowed the probang to pass. Beel believed that the periodicity of the symptoms was caused by masses of food inducing occasional occlusion at this spot. Microscopical examination gave similar results to those described by Fessler. The growth illustrated (Fig. 348) is of an analogous character—viz., papilloma coralliforme. Koch found tuberculous abscesses in the œsophageal walls in cows. In dogs of tropical countries (Java) cysts have been discovered in the œsophageal walls, which were filled with spiroptera sanguinolenta, and had completely occluded the œsophagus. Harms, during the autumn, found female *filariæ* beneath the œsophageal epithelium in sheep. In dogs spiroptera sanguinolenta often occurs in the œsophagus.

These new growths, varying in size and form, produce greater or less difficulty in deglutition; often after great effort only fluids can be swallowed. Sometimes suffocation and vomiting occur; wasting is a regular result. Curability depends on the condition and number of the growths, and on whether they can be reached. Polypi with narrow pedicles may be torn off and discharged during violent vomiting. In carnivora, as in man, these usually have their seat in the pharynx or close behind it, and during vomiting may be thrown forward into the pharynx, and can then be removed, as shown by a case reported by Dierickx. Where the swelling in the neck portion of the œsophagus can be detected externally, which, however, is seldom the case, it may be removed by performing œsophagotomy. The uncertainty of diagnosis during life generally prevents rational treatment. Lorenz saw a horse die from pleurisy, and found a carcinoma which had led to rupture of the œsophagus. Molni detected a tumour in the left œsophageal furrow in a cow, which, after each feeding time, showed tympanites. He regarded the case as one of goitre.

VIII.—DISEASES OF THE LARYNX AND TRACHEA.

(1.) INJURIES, INFLAMMATIONS, AND TUMOURS IN THE LARYNX. (LARYNGITIS. PERILARYNGITIS.)

ONLY in carnivora is the larynx accessible to direct inspection. This is effected for clinical purposes by drawing out the tongue and depressing it with some blunt instrument (spatula). The laryngeal mirror used by Nawratil and Schmidt is of little value, and is seldom used on account of the animal's resistance. Until recently, inspection of the larynx in the larger animals appeared impossible, but Polansky and Schindelka, with the assistance of the Vienna optician Leiter, have constructed instruments for examining the larynx and pharynx of the horse, and amongst others the rhino-laryngoscope, which affords not only clear but extensive views of this region. Its construction is complicated, its use requires the electric light, and its application in veterinary practice has accordingly as yet been limited; but it is very serviceable for clinical observation and for teaching.

On account of its protected position between the branches of the lower jaw, the larynx seldom suffers from injuries from without, though sharp foreign bodies swallowed with the food may pierce and inflame the mucous membrane. Rowland removed from the pharynx of a horse a fish-hook, which had penetrated the larynx. Injuries of the larynx occur oftener than is supposed, but not so frequently as those of the pharynx, and produce either acute or chronic inflammatory processes. The acute are clinically comprised under acute laryngitis, and are considered in the text-books on special pathology and therapeutics. The chronic lead to proliferation of connective tissue in the neighbourhood of the laryngeal cartilages (perilaryngitis chronica fibrosa) or pus formation.

Kühnert saw a case of suppurative laryngeal perichondritis in

a pig. An abscess had formed in the submucous tissue of the right arytenoid cartilage, and caused marked narrowing of the glottis, with dyspnœa; the animal was slaughtered. Leisering detected swelling of the vocal cords and of the mucous membrane of the laryngeal pouches in a dog which had suffered from severe cough; and Hutchinson makes a similar report of a pig, killed on account of dyspnœa. Necrosis of the cricoid cartilage had occurred.

Perilaryngitis chronica fibrosa is commonest in horses. Progressive increase of connective tissue occurs, which sometimes undergoes ossification; its retraction fixes the arytenoid cartilages, narrowing the glottis, and producing more or less severe dyspnœa. Gurlt reports this condition in a horse which had suffered from broken wind. The larynx was ossified. Werner writes of an ox which, after suffering for over a year from gradually increasing difficulty in breathing, was found to have a laryngeal growth which extended into the trachea. Möller has often seen chronic perilaryngitis in horses. In four cases no cause could be discovered; another happened after resection of the arytenoid cartilage, causing failure of the operation. Chronic inflammatory diseases of the mucous membrane of the larynx are not very rare. In cows tuberculous processes occur. In horses and dogs chronic catarrh of the larynx is occasionally seen, though it seldom requires surgical treatment. Chronic irritation in the deep layers of the mucous membrane, causing proliferation, occurs oftenest on the vocal cords, which become much thickened. Lee found both vocal cords in a horse covered with cartilaginous growths.

Symptoms. Chronic laryngitis and perilaryngitis are recognised primarily by dyspnœa, which ensues more rapidly in cases where pus formation is proceeding than in those where connective tissue is being formed. At first inspiratory dyspnœa is alone recognisable, but later difficulty in expiration may also be noted. So long as the difficulty is confined to inspiration, the disease cannot easily be distinguished from paralysis of the recurrent nerve, and is clinically included under the term whistling or roaring. External examination seldom discovers any structural changes, but if the process has extended to the outer surface of the cricoid and thyroid cartilages, the larynx appears of unusual size, although its outlines seem less sharply defined. Ossification is recognised by hardness and resistance to pressure, usually first remarked on attempting to make the horse cough by squeezing the larynx. Laryngitis chronica, with thickening of the mucous membrane, gradually produces dyspnœa, whistling sets in, sometimes in aggravated form, and may be noted both in inspiration

and expiration, or may not differ from that produced by paralysis of the recurrent nerve. A further symptom of disease of the vocal cords is marked hoarseness or loss of voice (aphonia).

Tumours are most frequent in oxen, though also found in horses and other animals. Their general position at the base of the epiglottis makes it probable that many are actinomycotic. The new growths described as cystic tumours of the larynx are possibly of this character. Gurlt describes the majority of the tumours in the larynx as polypi. Some may be mycotic, especially those associated with pus formation. A laryngeal tumour of the ox, discovered by Peschel, was stated by Johne to be an adenoma of the mucous glands.

Lee removed a cartilaginous growth from the vocal cord of a horse which had suffered from broken wind and was unable to neigh; recovery was complete in six weeks. Besnard lost a six-year-old mare by suffocation produced by a pedunculated cystic polypus, as large as a walnut, which had its seat at the base of the epiglottis, and caused difficulty in swallowing, together with severe dyspnoea and attacks of coughing. Dégive believed that the dyspnoea arose from the epiglottis being pushed into the larynx by the swelling during deglutition, and not by the cyst being swallowed, as Besnard thought. Lehnhard found a retention cyst, as large as a hen's egg and full of clear fluid, on the anterior surface of the epiglottis in a horse which had suddenly died from suffocation.

Tuberculosis of the larynx is common in oxen. Confusion with actinomycotic tumours often occurs, but a case of tuberculous new growth in the larynx of an ox was described by Johne, who had already drawn attention to the similarity of the two diseases. Prietsch and others noted tuberculosis of the larynx in cows on post-mortem.

Cadiot and Dollar ("Clinical Veterinary Medicine and Surgery") describe a number of cases of tuberculous ulcer of the neck in the dog and cat. The pathogeny of the condition is as follows:—In animals with tuberculous lesions of the lung coughing is common, and virulent tuberculous material is continually being passed into the pharynx, the mucous membrane of which becomes inoculated (auto-inoculation). The disease soon extends to the neighbouring lymphatic glands, which become inflamed. Suppuration of the surrounding tissues and ulceration of the skin follow. The wound thus produced rarely heals, and in most of the cases death occurs within a few weeks or months.

Symptoms and progress. The first stages in the development of new growths are naturally beyond the field of clinical observation. Dyspnoea and, under certain circumstances, disturbance in swallowing are only produced after the growths have reached a certain size. On the epiglottis, however, they may attain considerable

dimensions before marked symptoms appear ; but difficulty both of breathing and swallowing are then noted. As in diseases of the tongue, and in the so-called pharyngeal lymphoma, dyspnœa may occur, particularly during feeding. The disturbed respiration and deglutition are not uniform in their appearance, as Fricker and Dieck have noted in horses. Pedunculated tumours at the base of the tongue, dropping on to the larynx, may suddenly produce symptoms of severe inspiratory dyspnœa, causing the animals to fall and occasionally to die of asphyxia. The sudden appearance of dyspnœa, without febrile or other constitutional disturbance, denotes the presence of such tumours. The condition may be easily mistaken for œdema of the glottis.

The exterior of the larynx is seldom visibly altered. Only where the new growth has spread to the exterior, or has produced marked changes in the wall of the trachea, does the region of the larynx appear fuller and swelling show itself. Prietsch also observed this in cows which suffered from laryngeal tuberculosis.

Examination through the mouth often gives more definite information. In carnivora, by drawing forward the tongue with a cloth and pressing down its base with a spatula it is possible to view the interior of the larynx and determine the presence of tumours on its upper borders. In horses this may be effected with the laryngoscope constructed by Polansky and Schindelka. When this instrument is not available, the pharynx may sometimes be examined when the horse is cast, provided the position of the molars and the soft palate allow the passage of the hand. Such examination is more easy in oxen, and, if the head is fixed, may be made while the animal is standing.

In doubtful cases the larynx can be opened and a view of its interior obtained, an operation entirely without danger, and to be resorted to whenever it is important positively to ascertain whether or not disease exists within the tube.

Tumours in the trachea are first remarked when they narrow the lumen of the tube considerably, and produce dyspnœa. This is generally accompanied by loud breathing sounds, which occur both during inspiration and expiration, though occasionally only during expiration. It is characteristic of tumours in the trachea that the noise appears especially during expiration. The position and nature of the new growth explain this peculiarity. Dyspnœa increases with the growth of the swelling, and may terminate in suffocation. Only where malignant tumours perforate the wall of the trachea and extend outwards can their presence be directly

recognised. Diagnosis is rarely aided by palpation of the trachea; but pressure on the diseased spot may, perhaps, increase or decrease the dyspnœa.

Prognosis is in general unfavourable. Abscess formation and the discharge of pus into the trachea may occasion pneumonia. In chronic laryngitis with thickening of the mucous membrane, resection of the vocal cords may be serviceable. Prognosis of perilaryngitis fibrosa depends in great part on the degree of dyspnœa. Tracheotomy is certainly a palliative. The prognosis of most laryngeal tumours is unfavourable; but pedunculated growths, situated within the larynx, may sometimes be removed without recurrence, section being made of the cricoid cartilage and first rings of the trachea. Where the operation is unsuccessful, tracheotomy will still render the animals workable.

Treatment. Tumours on the epiglottis can sometimes be removed in the same way as pharyngeal tumours in cattle, by tearing them away with the hand; in dogs, with the assistance of instruments. Dieck removed a swelling as large as a hen's egg from the epiglottis of a horse with a specially-constructed instrument in the form of a hooked knife. Tumours on the vocal cords can be excised. The horse should be cast, and, if restless, anæsthetised. The hair over the larynx is shaved, and a cut made through the skin in the middle line, from the thyroid prominence to below the 1st or 2nd tracheal ring. After checking bleeding, the second cut is made, dividing the subscapulo-hyoideus and the sterno-thyro-hyoideus exactly in the middle line. This exposes the cricoid cartilage and trachea, which are then incised. The edges of the wound are held apart with broad hooks or retractors. Where a tampon-cannula (Fig. 349) is available, it may be inserted in the trachea to prevent entrance of blood. The finger is introduced into the larynx, the vocal cords examined, and the tumour is excised with scissors. Bleeding is slight, and is of no importance if a tampon-cannula has been used. The tampon-cannula may be removed next day, but, for safety, it may be left in position for some days, especially

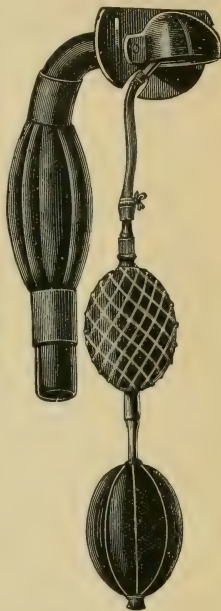


FIG. 349.—Tampon-cannula or Trendelenberg-cannula.

when the animal is not under the eye of the operator. Serious œdema of the mucous membrane and dyspnœa occasionally occur, but are rare. In dealing with new growths removal must be complete; Paquelin's cautery, in certain circumstances, does good service, and also checks bleeding. Where marked dyspnœa exists, or occurs periodically, tracheotomy must either be performed before casting the horse, and a cannula inserted; or the instruments must be in readiness, so that, in case of need, a tube can be inserted. In the treatment of perilaryngitis chronica fibrosa, or of new growths with broad bases in the larynx, tracheotomy below the growth is the only means of removing dyspnœa.

(2.) NEUROSES OF THE LARYNX—SPASM OF THE RIMA-GLOTTIDIS—LARYNGISMUS STRIDULUS—HEMIPLEGIA AND DIPLEGIA LARYNGIS.

These terms are applied to attacks of difficult breathing, occurring periodically, and apparently caused by spasmodic closure of the rima-glottidis. As a rule, the dyspnœa is inspiratory, and may occasionally be so severe as to constitute apnœa,—that is, temporary cessation of respiration.

The causes consist in either direct irritation of the mucous membrane or in reflex irritation of the nerves supplying the muscles of the larynx. Records of many such cases have been published, but are seldom sufficient to determine the exact cause of the attack. Acute inflammatory changes, catarrh, œdema of the glottis, food materials, or foreign bodies in the upper air passages, have all been assigned as causes. Post-mortem examination has discovered tumours in the pharynx, larynx, or trachea, but true neuroses of the larynx are occasionally met with.

Ebinger describes a horse suddenly attacked by severe dyspnœa, threatening suffocation, and accompanied by roaring. When at rest the breathing was normal and the health undisturbed, but the slightest work or pressure on the larynx, or indeed on any point of the neck above the jugular furrow, caused immediately severe dyspnœa and marked roaring, which continued during the next 8-10 respirations. Light pressure sufficed again to produce the attack. The symptoms disappeared after eight days' treatment with subcutaneous injections of acetate of morphine. Ebinger, not without justification, believes this to have been a neurosis of the recurrent nerve. The cases described by Holzendorf and Neumann as spasm of the larynx, or cramp of the muscles of the glottis, may have been due to other causes. In that recorded by Holzendorf, inflammatory disease of the larynx was clearly present; while the obstinate dyspnœa treated by Neumann does not appear to have been neuropathic.

Möller saw similar cases, apparently of neuropathic origin, in otherwise healthy horses; Seffner in horses recovering from acute bronchitis. King and Robertson referred similar attacks to ingestion of certain leguminous seeds, which they consider had a specific action on the recurrent nerve. Trumbower describes six cases of spasm of the larynx in horses which worked together in the same field. Death occurred in a few hours. Post-mortem examination showed the existence of acute laryngitis.

When danger of suffocation is associated with these conditions, tracheotomy must be resorted to at once. It is further noteworthy that inspiratory dyspnoea is increased by the anxiety and unrest associated with it. All excitement should, therefore, be avoided, and the horse placed in a quiet, well ventilated stall. Caution must be observed in the use of morphine; doses over 8 grains often cause excitement. Clysters of chloral hydrate deserve preference. Preisnitz's poultices, prepared by dipping poroplastic or thick felt in hot water, may be applied to the throat and neck, but must not be heavy, and may sometimes be replaced by dry coverings.

Myopathic paralysis of single muscles, or of groups of laryngeal muscles, is not known in animals, but may possibly occur. Neuropathic paralysis of the muscles of one side of the larynx (hemiplegia laryngis) is, however, very frequent in horses. The greater number, if not all the muscles of the larynx, which move the vocal cord are supplied by the recurrent nerve. A second branch of the vagus has been recognised by Exner as a motor nerve to the larynx, but it has not yet been determined what influence it exerts on the function of its muscles. From the construction of the larynx, as a valve opening outwards, it is clear that simultaneous paralysis of the constrictors and dilators must cause disturbed breathing during inspiration. Should the dilators of the larynx become paralysed, the arytenoid cartilages are forced towards the opening of the glottis by the instreaming air, and roaring results. With a few exceptions it is caused by paralysis of the recurrent nerve, and is so described in the text-books, as well as in another section of the present work. This paralysis is usually incurable, but the associated dyspnoea may be considerably relieved by removing the passive arytenoid cartilage, or by excising the lining of the laryngeal ventricle, or by tracheotomy, thus providing a direct entrance for the air below the larynx.

Roaring is also occasionally seen in other animals besides the horse; Utz and Ollmann found it in cows. Esser has described paralysis of the recurrent in a dog, and Möller noted the disease in two dogs. Möller also records several cases of double-sided paralysis of the larynx (diplegia laryngis) in horses and dogs producing severe inspiratory dyspnoea. After being walked for a short time, whistling

or roaring was produced. The condition generally pursues a chronic course, and may be taken for chronic inflammation or tumour formation in the larynx.

Diagnosis of roaring belongs to the province of special pathology, but the detection of double-sided paralysis of the larynx and its distinction from chronic inflammation or tumour formation may call for operative interference, or for the use of the rhino-laryngoscope. By using the latter instrument one sees clearly at the moment of inspiration that the two arytenoids sink downwards and approach each other, and in paralysis may even come in contact, obstructing the larynx. If not provided with this instrument, one may divide the cricoid cartilage and crico-thyroid ligament, and directly examine the interior of the larynx and the state of the arytenoid cartilages. Whilst in the normal larynx they make distinct to-and-fro movements, especially during forced inspiration, in diplegia laryngis they are found motionless.

Starting with the hypothesis that the cause of paralysis is situated in the intrathoracic portion of the nerve, McDonald attempted to unite the ascending (cervical) portion of the recurrent to the spinal accessory, and thus to "short-circuit" the nervous impulses. Both he and Haslam claim to have had good results. Other operators, however, have been unsuccessful, partly because of the necessarily delicate manipulation involved, but more probably because of the serious changes that had already occurred in the nerves and muscles.

(3.) FRACTURE, DEFORMITY, AND STENOSIS OF THE TRACHEA.

Injuries to the trachea having already received attention as complications of wounds in the neck, there remain for consideration those subcutaneous solutions of continuity which, when affecting the cartilaginous rings, are described as fractures. These injuries result from the forcible action of blunt bodies on the air tube; in horses are caused by the impact of the carriage pole, by contact with projecting bodies, or by falling whilst haltered tightly. In dogs fractures of the cartilages and rupture of the inter-annular ligaments are often caused by wire snares, and by bites.

Bru noted rupture of the ligaments between the first three tracheal rings in a mule. Walley saw a fox-terrier in which the trachea was torn across; death occurred very rapidly. Cajöry found the trachea almost completely torn from the larynx in a horse which had died in a stall after a sudden attack of dyspnoea. Von Bockum-Dolffs saw a horse suffer from emphysema of the neck and severe dyspnoea, in consequence of having run against the pole of a passing carriage. Tracheotomy removed the

difficulty in swallowing and breathing, and the animal again became fit for work.

But such injuries cannot always be successfully treated; deformities of the trachea sometimes result; extensive wounds produce stenosis of the trachea, accompanied by dyspnœa. Schwanefeld describes a horse in which the trachea was flattened about the middle of the neck and greatly narrowed. The presence of a stallion in the stable excited it and induced suffocation. Some deformities of the trachea are clearly congenital. Occasionally the posterior ends of the tracheal rings are bent inwards, or flattened so that the lumen forms merely a narrow fissure.

Gurlt saw a dog with marked flattening of the air tube. Harms and Hagen note similar cases in cows. Johnes describes two instances of dilatation in horses, one about 24 inches in length, and a similar condition was recorded by Bartenstein. Vegezzi found the dorsal surface of the air tube of a horse presenting a furrow produced by bending inwards of the ends of the cartilages and rupture of the inter-annular ligament. In this furrow lay the œsophagus, carotid, vagus, and sympathetic. Eberbach describes a horse in which dyspnœa was caused by compression of the trachea, due to a large sarcoma (compression stenosis).

The intact condition of the mucous membrane and the extension of the change throughout the trachea shows the deformity to be congenital. Compression, with narrowing of the trachea, may also result from goitre, from enlargement of the bronchial glands, or from tumour formation. Johnes relates a case in a giraffe, and Dietrich another in a foal which had died with symptoms of suffocation. Between the first pair of ribs was a diseased gland, which had compressed the trachea and caused suffocation.

Cicatricial stenosis of the trachea is not an infrequent result of tracheotomy, especially in foals, or where the tube, worn for a long period, does not fit well. Chronic perichondritis, resulting from the continued irritation, induces formation of new fibrous tissue, which sometimes ossifies, and narrows the lumen of the tube by contracting around it. Thus Tiede found the trachea narrowed to the size of a goose quill. Stricture is not always a result of unskillfulness in performing tracheotomy or in selecting a tube, for stenosis sometimes recurs in horses in which tracheotomy has been performed below a previous stricture.

The symptoms of injury to the trachea are difficulty in breathing, and emphysema of the neck, with localised inflammation, swelling, and pain. The degree to which the lumen of the tube is narrowed in consequence of hæmorrhage, dislocation of its cartilages, or inflammatory swelling, determines the extent of the respiratory

disturbance, which may become so great as finally to produce suffocation. In other cases a loud sound is heard both during inspiration and expiration. Very slight changes in the trachea are sufficient to produce it. Sometimes the noise may be increased or diminished by pressing on a particular part of the trachea. Laying the ear on the wind-pipe, the position of the stenosis may be more exactly fixed, but this method does not always prevent mistakes. During the next few days the emphysema usually spreads over the body, especially when coughing exists, but disappears later, generally without bad results.

The course of the injury depends on its extent and the resulting bleeding. The animal may be completely restored to usefulness, or difficulty in breathing may remain (asthma tracheale). The dyspnœa depends partly on the degree of stenosis, partly on the character of work performed. In spite of marked deformity, dyspnœa may be absent, whilst apparently unimportant changes sometimes produce greatly disturbed respiration; indeed, Schwanefeld's case shows that they may cause death. These diversities are explained by the fact that the respiratory difficulty is determined, not by the external deformity of the trachea, but by the degree of stenosis. The gravity of such cases is gauged by the state of the respiration during severe work. In stenosis of the upper portions of the trachea, tracheotomy usually affords relief, but is not available when the lower portions in the neck or thoracic cavity are affected. Such conditions, however, are often aggravated by lapse of time.

Treatment. Where great dyspnœa immediately follows injury of the trachea, tracheotomy, using a tampon-cannula, not only removes the threatened danger of suffocation, but also prevents the entrance of blood into the trachea. A tampon-cannula may be extemporised by carefully wrapping the stem of a Barthélemy's tracheal tube with cloth, but care must be taken that the bandage material, tow, wadding, or piece of sponge used for this purpose does not fall into the trachea. Severe emphysema, although seldom endangering life, may sometimes necessitate tracheotomy.

In stenosis the position and extent of the stricture must determine whether tracheotomy is applicable, or likely to be successful. It is generally serviceable when carried out below the stricture. Richolson, by removing a dislocated portion of cartilage, permanently relieved the dyspnœa. Similar cases are rare.

The interesting communication of Lafosse and Sticker show that "tubage" of the trachea is possible and may be successful. Lafosse divided the trachea below the stricture caused by tracheotomy,

thrust a cork cylinder, bound round with tow, into the trachea, and fixed it with tape. In ten days the cylinder was replaced by a tube, the latter was removed after six weeks, the trachea being then so far dilated as to admit of easy respiration without a cannula. Sticker dilated the trachea and larynx by means of a metallic spiral, which was left permanently in position.

(4.) FOREIGN BODIES, TUMOURS, AND PARASITES IN THE TRACHEA.

Foreign bodies seldom enter the trachea during life. Owing to the sensibility of the mucous membrane of the glottis, they immediately produce coughing, and are ejected. Masses of food have nevertheless been repeatedly found in the trachea both in oxen and horses. Tumours of the pharynx, which are common in cattle, sometimes interfere with swallowing, and favour the entrance of food into the trachea. In horses fluid medicines unskilfully administered occasionally pass into the trachea and bronchi. Dust enters with the inspired air, and may produce pneumonia, especially in horses. Abscesses in the walls of the pharynx or trachea, perforating the mucous membrane, may pour their contents into the air passage and produce fatal pneumonia. Rost saw a cow die thus from suffocation. In animals suffering from tetanus, saliva and medicine not infrequently find their way into the respiratory passages, and produce bronchial irritation. Blood derived from wounds or operations in the mouth, larynx, trachea, or neck may enter the air passage and clot there, producing coughing and occasionally suffocation. Badly-made tracheotomy tubes sometimes break, and a portion falls into the trachea. This may happen with cannulæ, in which the tube is not firmly fitted to the shield. Henderson reports such a case. During tracheotomy, if care is not taken, the disc of cartilage may be drawn into the trachea; it is carried up and down by the air stream, coughing follows and the disc is expelled through the operation wound. Other foreign bodies rarely enter the trachea, though a case is reported where a horse died in consequence of a stem of *Robinia pseudacacia* 12 inches long passing into the right bronchus, and producing pleuro-pneumonia with hydrothorax.

Tracheal tumours are rare, though they have been seen—principally in oxen. They are usually pedunculated, probably in consequence of being continually moved by the air stream. Gurlt, Gerlach, Hink, and others found tracheal polypi in oxen, Rieck and

Hink sarcomata. Siedamgrotzky describes a colloid cyst in a horse's trachea. It was found embedded in loose connective tissue just below the cricoid cartilage. Benjamin discovered in the anterior wall of the trachea a tumour, which had formed after an attack of sore throat, and produced difficulty in breathing. Besides the varieties of strongylus, usually occurring in numbers in the bronchi of ruminants and swine, acari have been seen in the trachea. Paulicki found them in a long-tailed monkey.

The symptoms are very varied. Dust or fluids obtaining entrance into the bronchi cause irritation and sometimes pneumonia. Food particles in quantity drawn into the bronchi may produce death from suffocation. A cow described by Grüll, which, till the moment of seizure had been perfectly healthy, suddenly died in the stall with symptoms of suffocation, and post-mortem showed the bronchi to be filled with food. Similar cases have repeatedly been observed. But Leisering has drawn attention to the fact that, in animals with incomplete closure of the cardia, and especially in ruminants, portions of the food after death may be forced up the œsophagus into the pharynx, thence into the trachea and bronchi. This is most likely to occur where the stomach has been full, or its contents in a state of fermentation, or the carcase has been moved. A case described by Werner was clearly produced in this way.

Dyspnœa and coughing result immediately the foreign body reaches the bronchi. The movement of the foreign body can sometimes be heard or felt from without. The narrowness of the rima-glottidis renders it difficult for solids that have entered thus far to make their exit, though they are often expelled by coughing. In Henderson's case, as reported, the tube of a tracheal cannula, which had slipped into the windpipe, was said to have been ejected through the mouth; but such a result is very exceptional. Tumours in the trachea only attract attention when they become large enough to obstruct the air passage and produce dyspnœa. A loud sound is then heard, both during inspiration and expiration. It is particularly characteristic of tracheal tumours that they cause a marked sound during expiration. The presence of a tumour can only be directly detected when it originates on the outer surface of the trachea, and thence breaks through the tracheal wall, as malignant new growths generally do. Otherwise the position of a tumour may be determined by palpation, pressure at a particular spot increasing or decreasing the dyspnœa and noise. This symptom is quite peculiar to tumours.

Treatment. Prophylactic treatment requires that in giving fluids to dogs and horses particular care should be taken, especially

if the animals are restive. The head must neither be raised too high, nor turned on its own axis. It is easy to judge of the action of such abnormal positions of the head by attempting to swallow whilst the head is either turned much towards the right or left. Such positions are, however, less dangerous in oxen. Very great care is required if the drugs are not in complete solution, or if they contain irritants. Should the animal cough when receiving a drench, administration should be suspended. Rubbing the neck is not only useless, but also dangerous, as coughing is thus easily induced.

Large, firm objects can usually be removed from the air passages only after tracheotomy. Removal is sometimes possible with the help of suitable forceps. If necessary, the fissure in the trachea can be lengthened, when the body may be forced out by the pressure of the expiratory current. Tumours can sometimes be removed in a similar fashion.

(5.) TRACHEOTOMY.

Tracheotomy consists in opening the trachea for the purpose of inserting a tube or cannula for the passage of air. The operation is adopted to prevent suffocation, or dyspnœa, arising from obstruction (œdema, abscess, tumour, paralysis, fracture, etc.) in the larynx, pharynx, or nasal passages; to remove foreign bodies from the trachea; and occasionally to carry out direct treatment of the interior of the larynx or trachea.

Tracheotomy is almost invariably restricted to horses, in which animals impaired respiration is commonest and interferes more seriously with usefulness. In ruminants diseases of the larynx are uncommon, and when they occur the animals are generally slaughtered. Owing to the comparatively long neck, and exposed position of the trachea, the operation offers less difficulty in horses than in cattle.

In animals, and especially in horses, there is a wide field for operation, comprising the space from the upper end of the trachea to near its entrance into the thorax. Günther prefers for the operation a point about one-third of the distance from the larynx to the chest, though he admits that it may be carried out higher or lower without disadvantage. Lafosse chooses the space between the third and fourth tracheal rings; Krieshaber, that between the larynx and trachea. As a rule, the space between the upper and middle thirds of the neck is the point selected, because it is convenient, interferes less with the appearance of the animal,

and in the event of stenosis supervening, the operation may be repeated at a lower point. The various complicated tracheotomes and trocars proposed by Brogniez, Marty, Gowing, Murray, Spooner, Thompson, Hayne and others, and intended to facilitate the operation, are seldom used. Two operation methods may be noticed: (1) Puncture, and (2) Incision of the trachea.



FIG. 350.
Hayne's
tracheal
trocar.

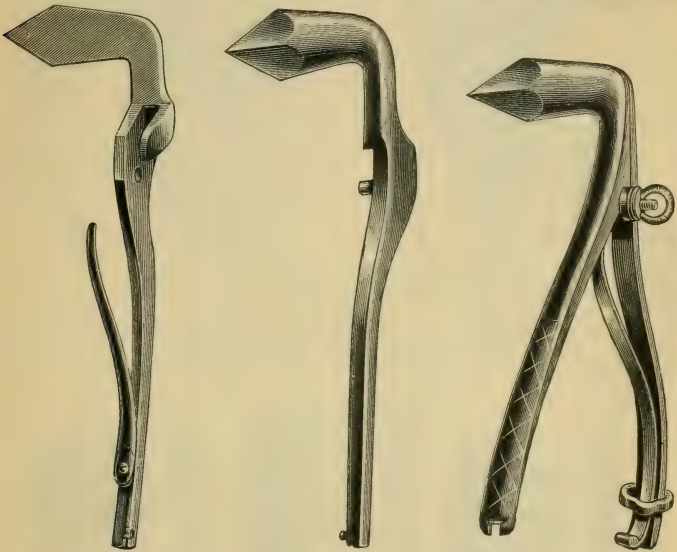
(1) Puncture of the trachea was recommended by Pilger, Gowing, Hayne, and others. Hayne's method met with most approval, and consisted in passing a trocar, provided with a cannula having lateral openings, transversely through the trachea (Fig. 350). This operation required some skill and care, particularly in a well-developed neck, in order to avoid injuring the jugular and carotid; while even the large cannula, used for heavy working-horses, did not admit sufficient air. The origin of this procedure, which does not possess even the advantage of being rapidly carried out, could only have been fear of using the knife. Thompson's tracheotome was designed to simplify operation, though its value is not great. It consists of special forceps (see Figures 351 to 355), with jaws bent at right angles to the limbs and externally ground to a sharp cutting edge. When closed, the head of the instrument is readily thrust through the skin and into the trachea; the jaws are then opened and the cannula slid into position between them. The figures very clearly show the instrument and the mode of using it.

(2) Incision into the trachea is most generally practised. The trachea may be opened by vertical section of several rings, or by excision of a portion of two or three rings. Vertical section or splitting, although it increases the difficulty in introducing the cannula, is sometimes preferred where the tube is to be worn only temporarily, is less apt to cause deformity and stenosis, and hence is generally commended in acute diseases like strangles for foals and race-horses, in which even slight dyspnoea is dreaded. The ex-

cision of a portion of the trachea facilitates the introduction and removal of the cannula for cleaning, and is specially desirable in all cases of chronic dyspnoea where a tube must be permanently worn by the horse. Experience does not justify the belief that stenosis

is more apt to result from partial excision of the cartilages than from splitting the trachea.

Tracheotomy is conveniently performed whilst the horse is standing. The animal should be placed so that the front of the neck is well lighted. A twitch is lightly applied, and the horse, if still restless, has each ear held by a strong man. The head is held well up, and the hair clipped from the seat of operation in a narrow strip, 3 to 4 inches in length, in the middle line of the neck. The operator grasps the skin with the left hand and lifts a horizontal



FIGS. 351, 352, 353.—Thompson's tracheotome.

fold about $\frac{1}{2}$ inch high, exactly in the centre of the shorn patch, and makes a vertical incision through the fold. This prevents the skin wound being made larger than intended, in consequence of the animal suddenly stretching the neck, though in phlegmatic horses, and those suffering from severe illness or dyspnœa, the precaution is hardly necessary.

The skin having been incised, the muscles lying below it are divided in the middle line, the proper point being indicated by its lighter colour (connective tissue), and the trachea is exposed. In well-bred horses with thin cervical muscles this procedure is very

simple ; but in fat horses there may be a little bleeding and more difficulty, though no danger. The edges of the wound are held



FIG. 354.—Making the incision.



FIG. 355.—Introducing the cannula.

apart with the fingers of the left hand, or with a retractor, while the connective tissue covering the trachea is divided in the middle

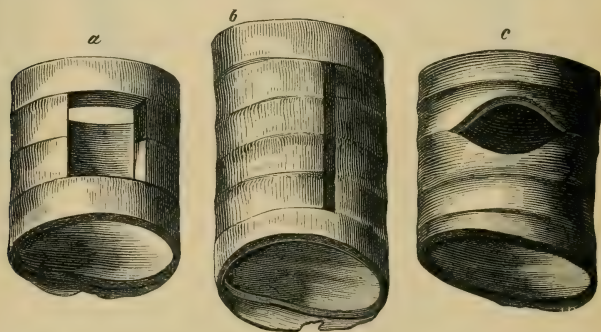


FIG. 356.—Method of performing tracheotomy.—*a*, Square opening ; *b*, vertical opening ; *c*, oval opening. (Hering.)

line. Up to this point the procedure is the same in both methods.

In the operation without removal of cartilage, the trachea is

now incised either perpendicularly through the third and fourth rings, or horizontally in the intervening ligament; or a vertical incision providing more room is made by thrusting the knife, with the cutting edge upwards, into the trachea at the lower edge of the wound, and carrying the cut upwards through two or three tracheal rings (Fig. 356). Hooks are now applied to the trachea, or the index and middle fingers of the left hand hold the edges of the wound apart, and the cannula is inserted. The trachea in the horse being of considerable size, little difficulty is met with, even when dealing with the hard cartilages of old subjects.

When the cannula is to be worn for a considerable period or permanently, and must, therefore, be removed at intervals to be cleaned, a round, oval, or occasionally a square piece is excised from the anterior wall of the air-tube. Viborg, who first recommended the square opening (Fig. 356, *a*), directs the knife to be inserted between two cartilages, and a horizontal cut made about $\frac{3}{4}$ inch in length. This cut should extend an equal distance on either side of the middle line. From each of its ends a vertical cut is next made downwards, and the piece of cartilage which now hangs by the intercartilaginous band below is grasped with dissecting forceps and cut away, care being taken to prevent it falling into the trachea. The cannula is then placed in position. Lafosse, Brogniez, and

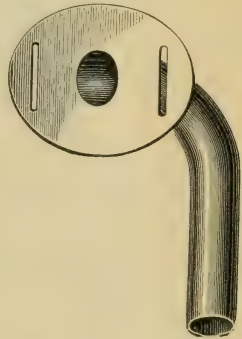


FIG. 357.—Barthélemy's cannula.

Günther have expressed themselves in favour of the oval opening, which may be produced by first dividing the intercartilaginous ligament and then excising a half-round piece from the cartilages above and below, without, however, quite dividing these (Fig. 356, *c*). Bending of the rings and stenosis of the trachea, which result from completely cutting through the cartilages, are thus avoided. Brogniez's tracheotome likewise produces an oval cut, but can be replaced by a bistoury, deftly manipulated. The same remark applies to other instruments, such as Marty's tracheotome, which removes a circular piece from the two cartilaginous rings, like a trephine. The tracheotome introduced by Mr. McKenny, of Dublin, is simple in action and very efficient; it cuts a circular opening large enough to accommodate a Jones' tube.

Tracheotomy is one of the simpler of equine operations, and is

easily carried out with a little care. Its success depends greatly on the cannula used.

Many of those recommended can only be employed in connection with their appropriate tracheotomes, and, therefore, may be disregarded. The oldest (Barthélemy's) consists of a metal tube, 4 to 8 inches in length and $\frac{3}{4}$ to 2 inches in width, bent at one end, and provided with a plate to hold it in position. The bend must be confined to the upper end, and

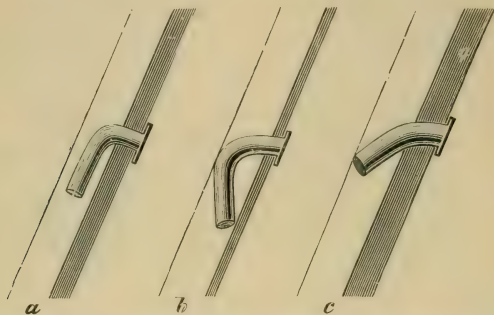


FIG. 358.—Position of tracheal cannula. *a*, Normal; *b*, when too much curved; *c*, when insufficiently curved.

must be suited to the thickness of the parts between the skin and front wall of the trachea. Where the bend is too short, not only will the skin and muscular tissues be bruised, but the lower end of the tube will press against the posterior wall of the trachea and produce inflammation with proliferations, leading to stenosis (Fig. 358, *c*). Where the bent portion is too long, there is undue space between the plate and the skin, and if such a tube be pressed home by tapes or straps, it becomes displaced and liable to injure both walls of the trachea (Fig. 358, *b*). Tracheotomy tubes, formerly made of tin-plate, are now much better manufactured of German silver.

The objection to Barthélemy's cannula, viz., that it falls out easily, may partially be obviated by straps (with buckles), fastened in the eyes of the plate and passed round the neck. They should not be carried too far forward, as the tube is then liable to fall out during coughing or violent expiratory movements. Barthélemy's tube somewhat disfigures the animal, and where used for long periods very careful fitting is necessary to prevent thickening and narrowing of the trachea. Occasionally, owing to the strap breaking and the tube falling out during the night, the horse has been found dead. This tube is therefore now seldom used for permanent wear. To overcome the above disadvantages models have been designed by Leblanc, Degive, Vachetta, Peuch, Field, Coleman, Jones, and others. Dispensing with the use of straps lessens disfigurement without interfering with the secure fixing of the cannula, and diminishes risk of bruising and irritation. The trachea remains unobstructed in an upward direction as far as the larynx, whilst the cannula is very easily cleaned. Leblanc has

constructed a jointed tube said to be adapted to every form of neck (Figs. 359 and 360), but one of the halves sometimes becomes detached and drops into the trachea. Modern experience shows that the tracheal tubes of

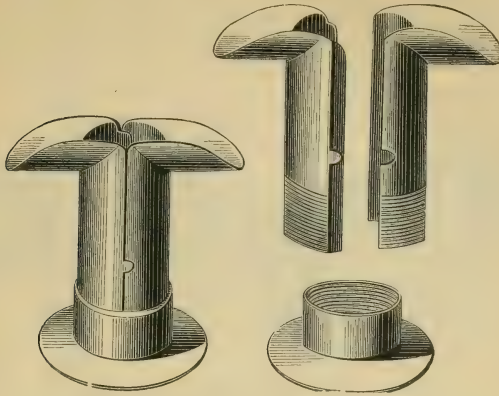


FIG. 359.—Leblanc's jointed cannula.

Field, Peuch, Jones, and Coleman, which correspond in principle, are amongst the best (Figs. 361 to 363). They consist of two or three pieces, which are inserted singly by first pushing the wider tube into the trachea and afterwards the narrower one, so that the projections point upwards

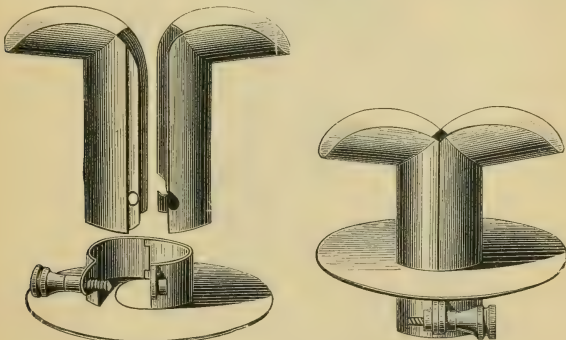


FIG. 360.—Leblanc's jointed cannula.

and downwards in the lumen of the trachea without pressing on its mucous membrane. Provided it is sufficiently long to enter easily, the tube with the shortest projections is to be preferred, because its hold is more secure and is less liable to injure the posterior wall of the trachea. Naturally, the length of the cannula, that is, the distance between the plate and the

curvature of the projections, must correspond to the thickness of the anterior wall of the neck. Such tubes may be worn by horses for several years without producing stenosis or difficulty in application. Hauptner has recently somewhat modified Peuch's tube. The inner portion is made lighter and can be more easily introduced; but, on the other hand, it has not so wide a basis, and, therefore, more easily produces proliferations. To introduce the tube the index finger of the left hand should first be

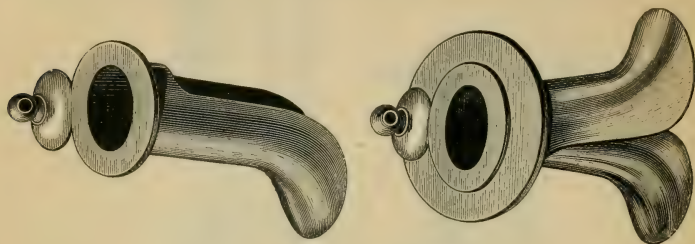


FIG. 361.—Peuch's cannula.

passed into the trachea, when the first limb of the tube may easily be slid along it, the finger acting as a guide. Afterwards the second portion is inserted.

Field's tube is largely used in England, and is convenient to insert

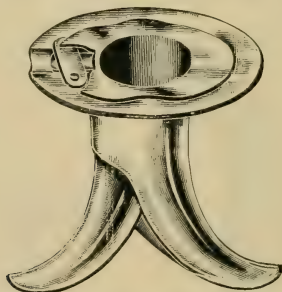


FIG. 362.—Field's tracheotomy tube.

and withdraw as well as to clean. The shields and half tubes should, however, be either in one piece or be very securely welded in order to prevent accidents.

Coleman's tube is also to be recommended as light, simple, and convenient. The parts are very firmly united when the tube is in position, and there is less danger of their being displaced by the patient than in the case of Field's tube.

Cannulæ must be light and durable, and their edges, as already stated, well rounded off. They are usually made of German silver, but their weight may be reduced by using aluminium, which has been employed

in making cannulæ on Peuch's model. These seem to be well suited for race-horses. Where it is necessary to combat suffocation occurring in purpura and other diseases, a cannula of a long form is selected, in order to avoid bruising the tissues at the point of operation. In anticipation of swelling supervening, the steadying of the cannula may be effected by

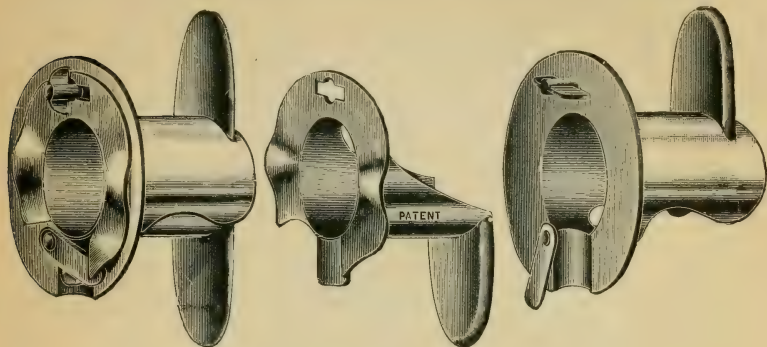


FIG. 363.—Coleman's tracheotomy tube.

placing one or more leather shields below the plate, or enveloping the projecting portion of the tube in gauze or tow.

The tube gradually becomes stopped by secretion from the mucous

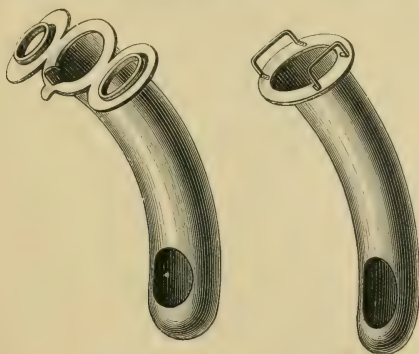


FIG. 364.—Double-tube cannula.

membrane, and must, therefore, be frequently cleansed, at first indeed, daily. As the secretion diminishes cleansing is only required at intervals of a week or ten days, and afterwards the tube should be disturbed as seldom as possible. It is advisable, however, to have two similar cannulæ, so that whilst one is in use, the other can be cleansed or, if need be, repaired. Such precautions are necessary, because the wound contracts very rapidly ;

indeed, after the lapse of an hour or two the introduction of the cannula may be difficult, or even impossible. Whilst the horse is in the stable, the opening of the tube may be covered with a metal cap, or stopped with a cork, which will prevent dust, seeds, etc., entering the windpipe. Double tubes have been recommended to obviate the necessity for changing the cannula. They are generally used in man (Fig. 364). Whilst the outer tube lies in the trachea, the inner can be cleaned from time to time. But this form, shown in Fig 364, must be condemned, because the curvature of the upper part is too slight, and that of the lower part too great; the lower portion, as already stated, should be quite straight. In double tubes this curvature cannot be avoided; hence they are unsuitable, and can only be used where the trachea is very near the surface. This model also possesses another fault—its opening lies at the side. Injuries from its lower border are certainly thus avoided, but the lateral opening coming in contact with the mucous membrane, hinders passage of air.

To obviate the necessity for a cannula, Strauss recommends cutting out an oval piece from the trachea, with precautions against injuring the mucous membrane, which is sutured to the skin. But Hering doubts whether this operation can be successfully done, and Möller's experience tends in the same direction. In the absence of a cannula, hooks may be introduced on either side into the tracheal opening, and held apart by tapes passed round the animal's neck.

As a temporary expedient, a piece of gaspipe, the neck of a bottle, or the spout of a coffee-pot may be inserted. To save animals from threatening suffocation, there is often insufficient time to proceed according to rule. Most practitioners, furnished merely with a bistoury, have on occasion been forced to operate in a dark stable, to find the middle line of the trachea as they best could, and insert a tube. Despite these difficulties, the parts usually heal well.

Krieshaber has recommended an operation under the title of "*trachéotomie sous-cricoidienne*," in which an incision is made immediately below the cricoid cartilage; the crico-tracheal ligament is divided, and a double-limbed cannula introduced. The position of this ligament is easily discovered by palpation, especially in horses, where the muscles of the neck are not greatly developed. With the head extended, the operation is not difficult in quiet animals. This method has the advantage of only slightly impairing the animal's appearance, and facilitates direct examination and treatment of the larynx, while the action of the tube, moreover, widens the larynx, and it is said that, after wearing the cannula for a time, animals sometimes cease roaring. This may perhaps result from the irritative process produced by the cannula fixing the arytenoid cartilage on the paralysed side.

The most frequent complications of tracheotomy are formation of excessive granulations round the wound and thickening of the mucous membrane with narrowing of the lumen of the trachea

(tracheal stenosis). Induration occasionally occurs in the skin and the soft tissues lying beneath, and usually follows cellulitis. Proliferation producing tracheal stenosis results from faulty formation of the cannula, from its being too heavy, badly made, or not

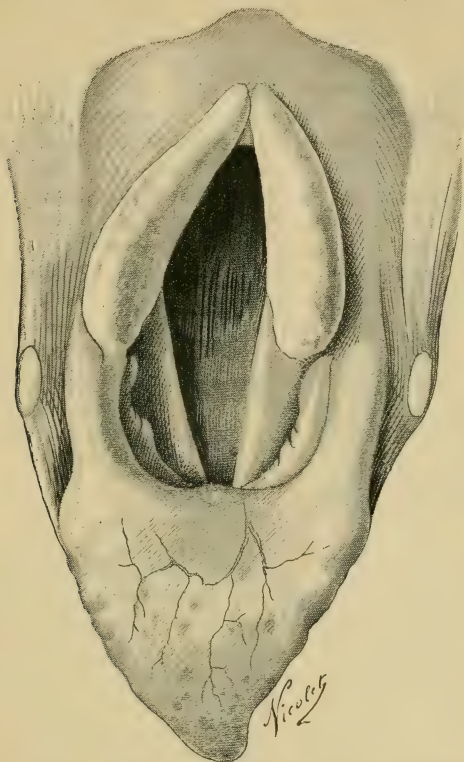


FIG. 365.—Superior orifice of the larynx and glottis of a horse affected with chronic roaring.

fitting the form of the neck. The cannula cannot fit well if it be too long, too narrow, too little, or too much bent, or if the opening in the trachea be too large. A pronounced tendency to such growths often exists in heavy horses, and though the cannula is perfect in every respect, the contraction recurs after each operation. Such stenosis gradually renders the introduction of the tube more and more difficult, and finally impossible. The tracheal opening must

then be increased, a procedure sometimes rendered difficult by ossification of the implicated cartilages. Where there is room, a second opening should be made lower down. In view of such a contingency, tracheotomy, especially in young horses, should be performed in the upper fourth of the neck.

Occasionally tracheotomy is followed by pneumonia, arising from aspiration of inflammatory exudate, wound discharge, or pus from a pharyngeal abscess, in such diseases as strangles, purpura hæmorrhagica, and acute laryngitis. This complication is prevented by the use of Trendelenburg's tampon-cannula, which, after being placed in position, is inflated with a bellows (Fig. 373). Where foreign materials are present in the trachea, they should, as far as possible, be removed with a feather mop, a soft bottle-brush, or a sponge carefully fastened to a wire. Such implements may without danger be passed as far as the division of the trachea. The tampon-cannula may then be placed in position and moderately inflated, that is to say, until the balloon fills the lumen of the trachea without exercising too much pressure on the mucous membrane, which might produce necrosis. Another pattern is Hahn's tampon-cannula, which carries a sponge tent. A substitute may be improvised by wrapping Barthélemy's cannula with a tow, gauze, or sponge, carefully secured with string or thread, so that it shall not become loose or fall into the trachea.

(6.) LARYNGOTOMY. LARYNGO-FISSURE.

This operation has been practised on horses in hemiplegia of the larynx, otherwise termed roaring.

K. Günther, in his earlier experiments, hesitated to divide the cricoid cartilage, because he feared stenosis, and therefore operated from the trachea. Stockfleth recommended dividing the cricoid cartilage, thus introducing laryngotomy into veterinary practice. Thyroidotomy and cricotomy are now distinctive terms, designating respectively division in the median line of the thyroid and cricoid cartilages. Where the upper rings of the trachea are also divided, the operation is styled crico-tracheotomy; while the division of the cricoid and thyroid cartilages, together with the connecting crico-thyroid ligament, is entitled crico-thyroidotomy.

Crico-tracheotomy, as adopted in the treatment of hemiplegia laryngis, was fully described in the brochure published by Möller in 1888.

The animal is chloroformed and placed on its back; the operator

kneels on the right side of the neck, shaves the hair from the larynx and upper portion of the trachea, and disinfects the site of operation. The position of the cricoid cartilage is easily determined by palpation. An incision, exactly in the middle line, is made through the skin, extending from the body of the cricoid cartilage as far as the first two or three rings of the trachea. After ligaturing any bleeding vessels, the muscles lying below the skin are divided exactly in the middle line. The trachea and cricoid cartilage are thus exposed with scarcely any bleeding, but any vessel spurting must at once be ligatured. An incision is made through the first two rings of the trachea with a pointed bistoury, turning the cutting edge towards the animal's head, and extending the opening by carrying the knife up to the thyroid cartilage. In case of vessels bleeding at this stage, the tampon-cannula should be inserted, inflated with air, and the vessels ligatured. The wound is now held open with a pair of blunt hooks or retractors, and after removal of any blood, the interior of the larynx can be seen.

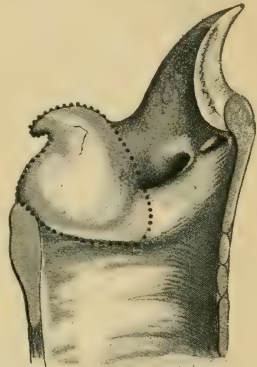


FIG. 366.—Möller's operation. Vertical and antero-posterior section of the larynx. The dotted line represents the mucous membrane covering the edges of the arytenoid cartilage.

Where tumours have to be excised, little difficulty is encountered, if their bases are not broad. Where there is paralysis of the recurrent, the arytenoid cartilage on the paralysed side is removed. While Günther and Stockfleth practised partial resection, Möller proposed total removal of this cartilage, and still prefers this method. With a specially-constructed scalpel (Fig. 367), the mucous membrane at the periphery of the arytenoid cartilage is divided. Beginning at the point of union of the arytenoid cartilages, the knife, carried through the mucous membrane and the interarytenoid ligament in an upward direction, close beside the middle line, follows the posterior border of the arytenoid cartilage upwards as far as the vocal process (in Fig. 368 the dotted line shows the course of the incision). The vocal cord is divided with scissors at its point of union with the arytenoid, and the cartilage separated from the muscles covering its outer surface with the fingers, scissors, or scalpel. By keeping close to the cartilage the bleeding is slight. The mucous

membrane is then divided from the anterior upper border of the arytenoid cartilage, care being taken to spare it as much as possible. For this purpose the index finger of the left hand is introduced into the sacculus laryngis, and the membrane cut through with scissors close to the border of the cartilage. In this procedure one is specially guided by the indications afforded by the left hand. The arytenoid



FIG. 367.
Scalpel for
resection of
arytenoid.

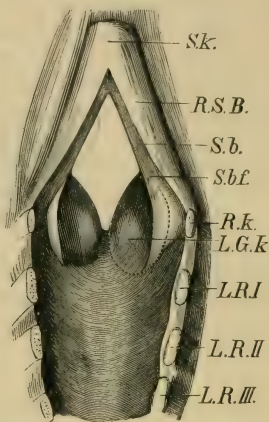


FIG. 368.—Course of incision.
Horse's larynx (seen from below). *S.k.*, Thyroid cartilage; *R.S.B.*, cricothyroid ligament; *S.b.*, vocal cord; *S.b.f.*, vocal process of arytenoid; *R.k.*, cricoid cartilage; *L.G.k.*, left arytenoid; *L.R.* (I., II., III.), first, second, and third rings of the trachea.

cartilage is now cut through with the scalpel, as near as possible to its articular surface, so that only a thin fragment of cartilage remains. This portion of the operation is the most difficult; especially in old horses, in which the articular process of the cartilage is often ossified. The knife must be inserted within and below, and the cut made upwards and outwards. As considerable force is often necessary in dividing the cartilage, it requires care to prevent the knife slipping off unexpectedly. As soon as the arytenoid cartilage is divided it may be easily freed from the neighbouring soft parts, and removed with the help of long and sharply-bent scissors. In this case, also, it is necessary to follow carefully the borders of the cartilage, holding the latter with a lion forceps (Fig. 370). Throughout the operation the larynx is cleared of blood by using small pledgets

of cotton wool held with forceps. Bleeding is usually slight, though in rare cases a spurting vessel may require to be closed by torsion. The introlaryngeal wound is swabbed with 10 per cent. chloride of zinc solution applied with a sponge, and is then powdered with 1 of iodoform to 3 of tannin.

Möller attempted to stitch the mucous membrane, using a curved needle (Fig. 371). It can be very well managed after a little practice. The needle, threaded with catgut, is first passed through the upper



FIG. 369.—Curved scissors.



FIG. 370.—Forceps for grasping the arytenoid.



FIG. 371.—Curved needle for suturing laryngeal mucous membrane.

fold of the membrane, which is then drawn downwards and fastened to the under border of the wound. Silk should be avoided, as in the larynx it remains little altered for months. Three sutures usually suffice to fix the membrane in position, to assist cicatrisation, and prevent the loose aryteno-epiglottidean folds interfering with breathing after healing. Removal of the vocal cord is unnecessary and injurious. A Trendelenberg tampon-cannula is introduced and secured in position by a couple of sutures inserted through the skin, and two pieces of tape passed round the neck.

The horse is now placed on its side and the hobbles removed; while, to prevent foreign bodies being inspired through the tracheal tube, a clean cloth should be laid under the neck. The animal is allowed to lie until it rises of its own accord, when it should be placed in a box, receive only hay and water, and not be tied up. It is

unnecessary to remove the tube and tampon after twenty-four hours, as was formerly done; both may remain in position three to four days without bad consequences, provided no marked fever results. This method, indeed, is to be preferred. Any discharge may be soaked up with a piece of sponge, or some cotton wool, and the wound, if dry, moistened with carbolic lotion. Drinking water should be kept constantly in the box, and given in a pail placed rather low

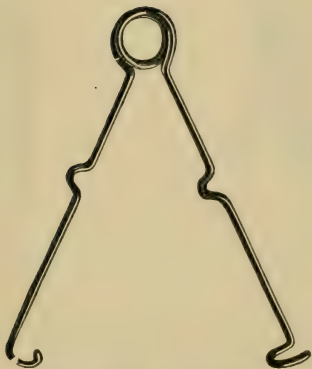


FIG. 372.—Spring hooks.

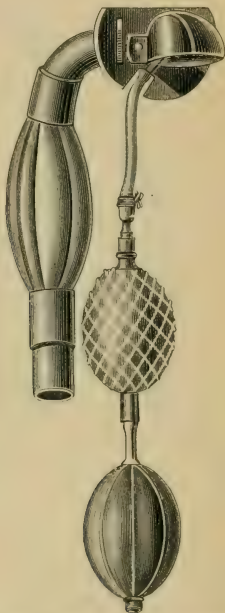


FIG. 373.—Trendelenburg cannula.

or on the ground. The diet should consist of hay and a small quantity of oats mixed with bran.

On the fourth day the surface of the wound is carefully cleansed, and the stitches in the skin loosened. The tampon-cannula can then be removed, and the larynx swabbed out with small sponges wrung out of carbolic solution; but the sponges must be nearly dry to prevent fluid running down the trachea. If in drinking, not more than a half-pint of water returns by the nose, the tube may be discarded. On the other hand, if fluid flows freely from the

nostrils, or if dyspnœa appear after the tube is removed, the latter must be replaced. The skin wound should be cleansed from discharge

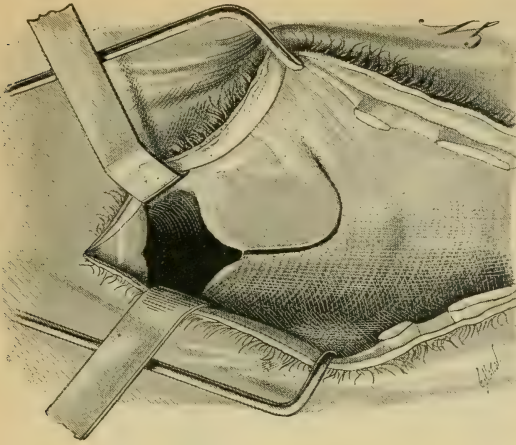


FIG. 375.—Third phase: (a) Incision of the mucous membrane of the superior and posterior edges of the arytenoid. In order to render the demonstration clearer, the incision of the second part is continued in front to the middle portion of the epiglottis, and backwards to the fourth tracheal ring.

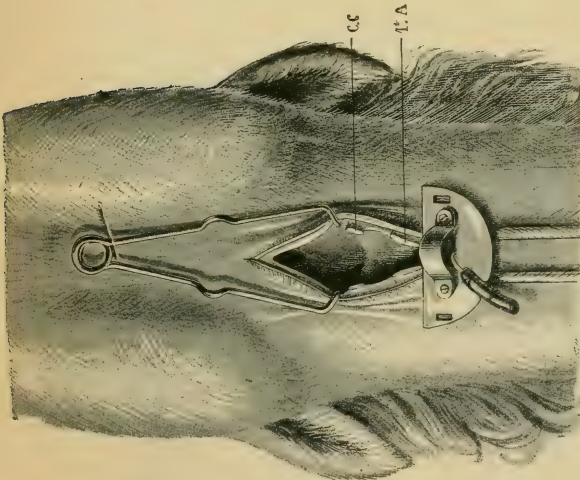


FIG. 374.—Arytenoidectomy. The second phase of the operation. The crico-thyroid ligament, the cricoid cartilage, the crico-tracheal ligament, and the two first rings of the trachea are cut through. The cannula and spring hooks are in position. CC, cricoid; 1st A, first tracheal ring.

daily until a dry scab forms, when, unless such complications as fever and dyspnœa appear, neither skin wound nor larynx will need treatment. The wound, as a rule, after eight days requires no special

attention. The horse, however, should still be confined in a well-ventilated box, and sparingly fed.

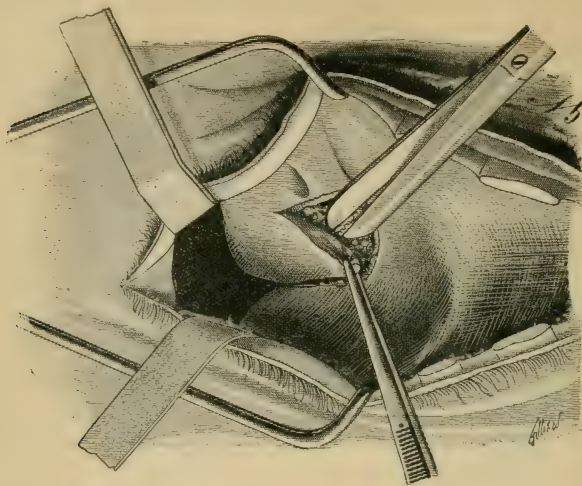


FIG. 377.—Third phase: (*b*) Dissection of the inferior edge and exterior surface of the arytenoid.

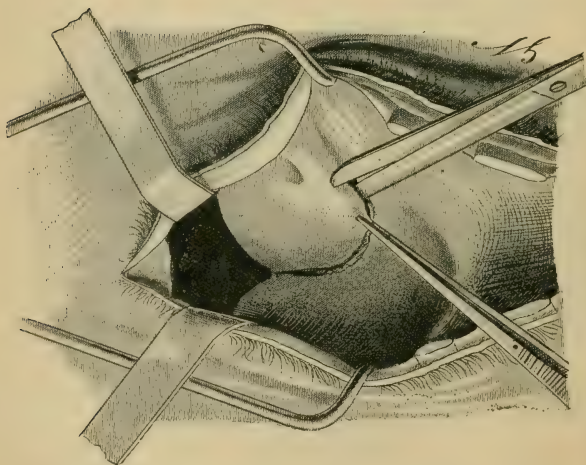


FIG. 376.—Third phase: (*b*) Section of the vocal cord.

The external wound usually closes completely in three to four weeks. It leaves a cicatrix, which contracts so far in five to six months that even an expert has difficulty in discovering it. In

about four weeks after the operation, the animal may be exercised daily, though for another month it must be kept from work of every

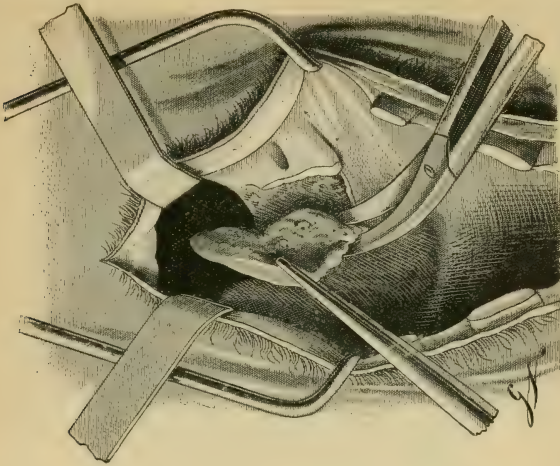


FIG. 379.—Third phase: (d) Excision of the cartilage with curved scissors.

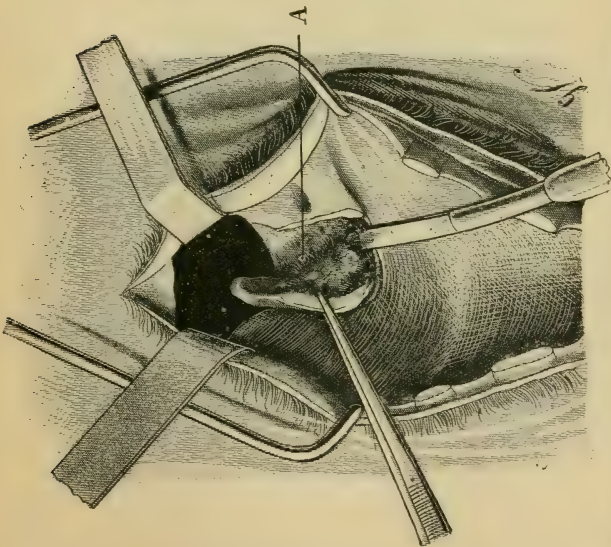


FIG. 378.—Third phase: (c) Section of the arytenoid close to its articular angle. A. Laryngeal branch of the thyroid artery.

description. After this time it may be ridden or driven until breathing becomes audible; but, as the forcible entrance of air

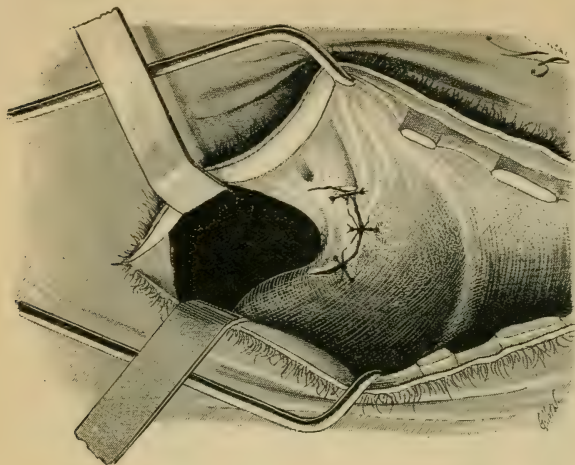


FIG. 381.—Termination of the suture. Position of the three stitches. The three threads should be nearly parallel to the middle line. The first should not have the oblique position indicated in the figure.

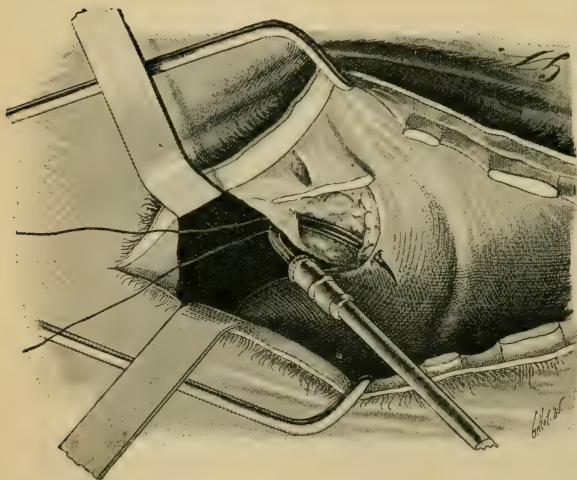


FIG. 380.—Fourth phase: Suture. Mode of passing the thread. The needle should penetrate the anterior and posterior lips at a point equidistant from the middle line and close to their free edges. In traversing the posterior lip of the wound, the needle should enter at a point somewhat deeper than indicated in the figure, but only the mucous membrane should be sutured.

stretches the cicatricial tissue, and may endanger the success of the operation, it should not be pushed beyond that point. Too early or injudicious work injures the animal and may produce failures.

In summer it is well to turn the patient out to grass for six or eight weeks.

Dyspnœa sometimes disappears in about eight weeks after the operation, but the process of cicatrisation often takes longer, and sometimes roaring only ceases in four to six months after operation.

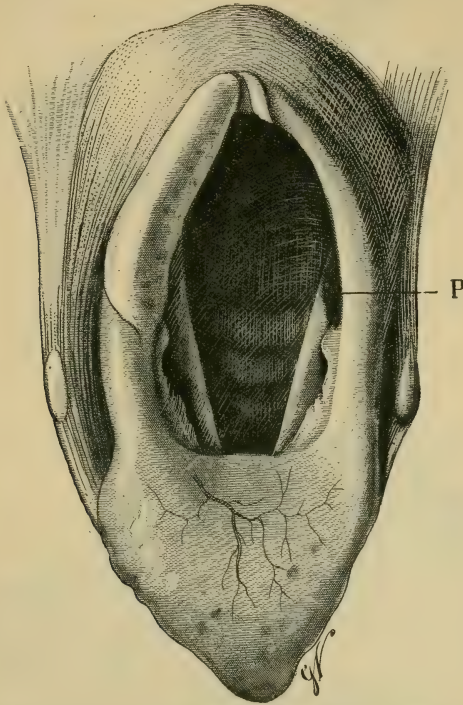


FIG. 382.—Superior opening of the larynx and glottis of a “roarer” that died of pneumonia eighteen days after the operation. The lips of the wound resulting from ablation of the arytenoid were not sutured. P, Partly healed wound.

This operation must not be expected to do more than render valuable horses, which are practically useless, owing to roaring, again capable of work. It will, however, do this in a certain proportion of cases. A number of horses operated on by Möller worked for several years. Some were used for riding, and even for racing. A race-horse, operated on in 1891, won £1,500 the next year, the roaring having completely disappeared. It cannot be denied that success

is sometimes remarkable. The use of a tracheal tube, apart from the discomfort it causes, has certain serious disadvantages; on the other hand, resection of the arytenoid cartilage only succeeds

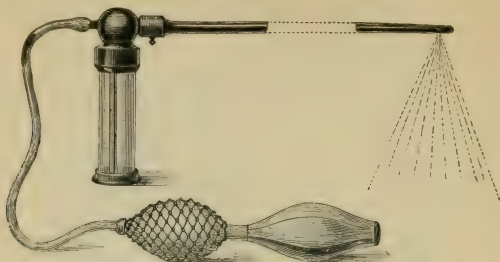


FIG. 383.—Pulveriser for disinfecting the laryngeal wound.

in a certain proportion of cases, and does not ensure removal of the loud or noisy breathing.

Before adopting arytenoidectomy, Möller tested the effects of

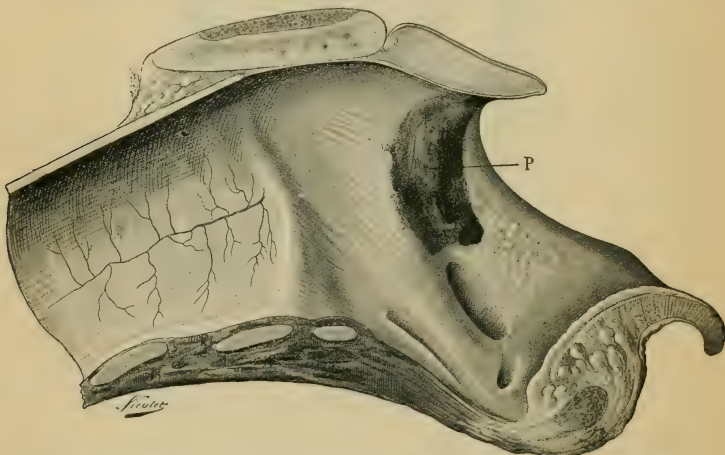


FIG. 384.—Antero-posterior section of the preceding larynx. P, Wound.

other operations on roaring horses. Having satisfied himself that excision of the vocal cords was useless as a remedy, Möller opened the crico-arytenoid articulation, with the intention of producing ankylosis or fixation of the passive arytenoid cartilage, but while

the state of many of the horses showed some improvement, the roaring did not disappear in any of them. Then he tried to secure permanent adhesion of the arytenoid to the thyroid cartilage, by means of a ligature passed through the thyroid plate, without opening the larynx or trachea, but generally the result was an aggravation of the noise. Myotomy of the paralysed posterior crico-arytenoid muscle was found equally inefficacious, and Möller arrived at the conclusion that complete excision of the arytenoid cartilage on the paralysed side is the only useful laryngeal operation for roaring. Cadiot has frequently performed arytenoidectomy more or less modified according to the particular case, but without increasing the proportion of successes, and he now practises excision of the paralysed arytenoid with suppression of the corresponding ventricle. Of four operations performed by Siedamgrotzky, one was completely successful, and three rendered the horses capable of work. Labat operated on five horses by this method. The first two died ; of the remaining three, two completely recovered, and one was much improved. Plosz operated five times ; three cases recovered completely, one incompletely, one failed entirely. Lanzillotti-Buonsanti used a cannula padded with gauze ; in one case pulmonary gangrene and death occurred, in the other distortion of the left side of the epiglottis. In six cases Blanchard removed a portion of the cricoid cartilage, and claims to have seen improvement. Liautard sutured the arytenoid cartilage to the crico-thyroid ligament and excised the vocal cord ; four cases are said to have recovered, and two to have been improved.

A number of cases of operation for roaring will be found described in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery."

Within the last two or three years the operation introduced by Dr. Williams of Cornell, U.S.A., of excising the mucous lining of the sacculus laryngis, or laryngeal ventricle, has been largely practised on roaring horses on the United States and in England. According to reports some horses have been cured, others have been greatly improved, while many have shown no change for the better, and there have been a few deaths soon after operation. The aim of this operation, which is sometimes performed on both sides of the larynx, is to secure permanent cicatricial adhesion between the opposed surfaces of the arytenoid and thyroid cartilages and obliteration of the laryngeal pouch.

At first a large opening was made into the larynx, the crico-tracheal ligament, crico-thyroid membrane, cricoid, one or two tracheal cartilages, and even the body of the thyroid shield, being divided,

but subsequently a much shorter incision was found sufficient for the operation, and now the opening is restricted to division of the crico-thyroid membrane. Up to the stage of entering the larynx, the procedure is very similar to that followed in performing arytenoidectomy. The crico-thyroid membrane is punctured and divided throughout in the middle line, from before backwards. A spring or other dilator is inserted to hold the thyroid plates well apart, while the mucous lining of the ventricle, seized with forceps, is incised all round the margin of the opening into the pouch, and then carefully detached by blunt dissection from the adjoining thyro-arytenoid muscle and cartilages. The pouch, which in shape resembles the finger of a glove, should be removed intact, though sometimes it is torn before separation has been effected. Usually there is little hæmorrhage, and this can be diminished by swabbing the ventricle with solution of adrenalin before incising the mucous membrane. The after-treatment consists in daily disinfection of the external wound, which heals in about three weeks. After closure of the outer wound, the horse should be rested for a further period of six to eight weeks. The chief immediate dangers of the operation are suffocation, from obstructive œdema of the glottis, and pneumonia. The former, which is more likely to follow excision of both pouches, can be prevented by inserting a tube, which is kept in position for 24 hours or longer if necessary. After giving satisfaction for six months to a year or longer following operation, the horse may be suddenly seized with acute dyspnœa, and if relief be not speedily afforded by tracheotomy or other means, death ensues from suffocation. Other occasional sequelæ are laryngeal fistula and general enlargement of the larynx.

DISEASES OF THE THORAX.

I.—FRACTURES OF THE RIBS—FRACTURÆ COSTARUM.

FRACTURES of the ribs are usually produced in the larger domesticated animals by external violence, by thrusts from carriage-poles, kicks, falling on uneven hard ground, unskilful casting, and in the case of runaways by collisions with obstructing objects ; in ruminants, from blows with the horns ; and in smaller animals from being run over, treads with the foot, or falling from considerable heights. Contused fractures are most common. Breakage seldom results from excessive muscular action, though Stockfleth has seen fracture of the first ribs produced in horses drawing heavy loads. Fractures of the ribs seem most frequent in swine, but are usually discovered only after death. Charpentier and Lafourcade, from observations in the slaughter-houses, found that 15 per cent. of swine had suffered fractures of the ribs, many of which had completely united. Simple transverse fractures are most common ; but sometimes the fracture is incomplete, the concave surface bending inwards, and the periosteum occasionally remaining uninjured (subperiosteal fracture). Less frequent are compound fractures, involving injury to the skin. In such fractures the pleura and lungs, or the peritoneum and abdominal walls, are sometimes injured. In a case of Grosswend's, a horse's last rib having been fractured, the fragments perforated the omentum and stomach.

The course taken is determined by the form and variety of the injury. Partial and simple subcutaneous fractures of the anterior ribs usually unite completely without marked symptoms. The great mobility of the posterior ribs interferes, however, with their union ; a callus fibrosus, or pseudoarthrosis forms, but does not impair health, and, indeed, is often only discovered after death.

Compound fractures, involving perforation of the skin, may lead to pus formation and necrosis of the rib ; but healing, even though complicated and long delayed, occurs. Should the sequestrum not be removed, a costal sinus may, however, develop.

When the pleura, lung, or peritoneal cavity is involved, the consequences are much graver. In penetrating injuries of the thorax, air frequently enters the pleural sac, but is commonly without danger ; for it has been found that air does not contain infective materials

in as large amount as was formerly believed. Hence, both in man and animals, unexpectedly good results not infrequently follow. Greater danger arises from pleurisy and pneumonia, or from injury to thoracic blood-vessels (*arteriæ intercostales et thoraciæ internæ*), which may lead to fatal hæmorrhage; in this connection fractures of the ribs are especially dangerous, as other large vessels may easily become damaged from this point. In a case in which a runaway horse struck against a tree, broke several ribs, and died in a few minutes, the post-mortem showed not only rupture of the blood-vessels at the anterior opening of the thorax, but injury to the heart by fragments of bone. Collisions with the carriage pole cause similar injuries.

Köhne treated a horse with complicated fracture of the ribs caused by collision with the pole of a carriage; though a large wound existed in the skin, both fracture and wound united in two months. Six months later a new swelling appeared, which broke, and discharged freely; the finger, introduced between the 9th and 10th ribs, discovered a large cavity from which the pus had come. The animal recovered, but was troubled later with chronic cough.

Injuries and ruptures of the diaphragm occasionally happen as complications of costal fractures. When broken ribs perforate the abdominal walls, fatal peritonitis is apt to ensue.

Symptoms. In partial and subcutaneous fractures there may only be somewhat hurried breathing, without further disturbance. Crepitation may sometimes be heard during breathing, and is the most reliable evidence of fracture. When the pleura is injured, there is a tendency to cough, and more rapid respiration: whilst where the lung is involved, the cough may be accompanied by blood-stained discharge from the nose or mouth, and subcutaneous emphysema. Fractures of the first ribs are accompanied by marked loss of power in the forelimb and disturbance in breathing, because of implication of the nerve supply of the muscles of the limb, and those of the thoracic wall. Rogers, Vennerholm, and many later observers have described such cases. Rogers was probably the first to point out that fracture of the first rib is frequently associated with symptoms of radial paralysis. Hunting's view, however, that all cases of "dropped elbow" (the chief symptom of radial paralysis) are due to fractured first rib is evidently too sweeping, and has been corrected by later observations. Rogers' case is reported in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery." Frick, in a dog with fracture of the left first rib, noted paralysis of the left recurrent nerve, hoarseness, asymmetry of the vocal cords, and alteration

in the voice. Recovery occurred in six weeks. When the skin is perforated the broken fragments can often be directly seen. Dogs with multiple fractures of the ribs usually show more pronounced disturbance, especially if many ribs are broken. The severity of the symptoms increases with the number of ribs broken and the degree of displacement.

Treatment in simple and partial fractures consists in keeping the animal quiet, and guarding it against work and movement. Even in complicated fractures, with injury of the pleura and lungs, nothing further may be necessary. Reduction in such cases is difficult. If the skin be broken, fragments of bone dislocated inwardly may be replaced by pushing a finger or hook under the anterior border of the rib, thus avoiding the vessel and nerve which pass down the posterior border. Antiseptic precautions should be observed, and a dressing with roller bandage afterwards applied to guard the wound against infection. Injury of the skin greatly increases danger, and under no circumstances should a wound be artificially produced for the object of reposition; it is much better to adopt an expectant treatment. Charpentier and Lafourcade, in 100 slaughtered swine found 15 with united fracture of the ribs, 10 without further injury, 5 with adhesion of the lungs, and 3 with pleuritic thickening. Cases of one broken rib were rare; and two or three were usually affected. The fracture occurred in the middle of the rib or in its lower portion. According to Stockfleth, the first ribs seem specially prone to break at their upper end.

II.—COSTAL SINUS.

CHRONIC inflammatory processes in the thoracic wall, with sinus formation, are more frequent in horses than in other animals. They result from necrosis of one or more ribs due to direct injuries or to cellulitis, occasionally to extension of infection in fistulous withers, or the formation of a strangles abscess. When depending on necrosis of bone, the sequestrum, if allowed to remain, causes chronic inflammation, with pus formation and thickening of the ribs and of their surroundings, which may persist for months and even years. The condition seldom leads to pleurisy, the fascia endothoracica and pleura becoming thickened, and preventing complication.

The symptoms consist in a swelling more or less diffused, seldom sharply defined, but hard and firm, without evidence of acute inflammation. A narrow opening exists in the centre of the swelling, and a probe passed through this is arrested by the hard, rough surface

of the rib. General disturbance is commonly wanting ; symptoms of pleurisy only occasionally occur, but when they do, almost invariably result in death.

Prognosis. The sequestrum prevents healing ; whether it can be removed depends on its size and position, and to ascertain this, operative interference is usually necessary. Prognosis is more favourable where the process is confined to the external surface of the rib ; but where it extends to the inner surface the condition becomes chronic, and pleurisy may supervene. The latter condition is indicated by the difficulty in breathing and the relatively copious discharge. But even with chronic necrosis of the outer surface, animals may remain useful for a long time.

Treatment. The direction and extent of the sinus has first to be discovered, bearing in mind that the middle of the swelling is the point beneath which the chief alterations exist. The sinus should be laid open freely, especially if it trends downwards, care being taken not to wound the external thoracic vessels. The exposed rib is scraped with a curette, the necrotic bone removed, and healing encouraged. Sinuses which cannot be laid open may be treated with antiseptics and astringents, such as liquor Villati, carbolic, or sublimate solution. When the sinus extends to the inner surface of the rib, non-irritant substances are selected. After removal of large pieces of bone, deep scars often remain in the chest wall. The resection of a piece of rib, although not easy, and involving danger of perforating the pleura, was effected in the horse by Ferguson sixty years ago, and may occasionally be necessary. In such case the necrotic portion is exposed by a long incision through the skin and subcutaneous tissues and periosteum. The periosteum is separated from the deep face of the rib, great care being taken not to perforate the pleura nor to injure the intercostal artery, which passes down the posterior face of the bone. The necrotic part is then removed by strong bone forceps. A drain is inserted in the lower part of the wound, which is sutured and covered with a dressing.

III.—STERNAL SINUS AND FRACTURE OF THE STERNUM.

STERNAL sinus is a condition almost entirely confined to the horse, in which, however, it is not uncommon, and is due to suppuration dependent on local necrosis of the sternum.

The sternum consists of a mass of spongy bone, and in horses is especially liable to be injured by falling or lying on uneven ground,

by the heels of a fore-shoe, by kicks, punctured wounds, or in stallions, by bruising the breast when covering. The bone is either directly injured, ostitis and necrosis resulting, or it is indirectly affected from cellulitis extending to it from the neighbouring textures. The thick muscular covering of the breast bone renders the removal of any necrotic portions difficult and tedious; infection meanwhile extends and new necrotic centres are formed, thus protracting the process for months or indefinitely. Frequently the sinus shows only a small opening from which a thick straw-coloured fluid is discharged in varying quantity. From time to time, abscesses form, and when these have been evacuated, the inflammatory process appears to subside, leaving considerable substernal swelling which gradually undergoes induration; the inflammation then either disappears or the substernal thickening becomes greater.

Brill described a sternal sinus with two openings below and three at the height of the costal cartilages in a colt $2\frac{1}{2}$ years old. Similar conditions have occasionally been seen in cattle. Delle mentions that a cow swallowed a splinter of glass, which perforated the rumen and lower wall of the chest, and produced sternal abscess and sinus. The glass was removed, and recovery occurred in five months.

Symptoms. A semi-soft, slightly painful swelling appears between the fore-limbs, sometimes exhibiting sinuous openings, from one or several of which offensive pus discharges. A probe introduced far enough strikes on the roughened surface of the necrotic bone. In other cases the chief symptom is substernal oedematous, slightly painful swelling, with at some point a small wound, more or less concealed by the sticky discharge which mats the hair forming a crust over the sinus. Occasionally the swelling interferes with movement of the fore-limbs, causing lameness or a straddling gait.

The Prognosis is unfavourable, though the disease is more disfiguring than deadly; occasionally, however, infection extends to the pleura, producing a fatal result. If treatment be attempted, it should be of an experimental character, and based on general principles. Many practitioners confine their efforts to dealing with the attacks of cellulitis.

Treatment. The disease is always chronic, recovery rare. Laying the parts open, removing necrotic portions of the sternum, careful disinfection, followed by the use of iodoform and other antiseptics, have usually been found useless. Günther testifies to the inveteracy of the disease. It is seldom worth while to carry out a tiresome, costly, and rarely effectual treatment. Isolated recoveries may, however, occur. The sinus may be favourably situated for efficient

drainage. If not, free exit for discharge must be provided. Disinfectant injections should be tried, and the wound kept clean. Where possible, the diseased bone should be scraped with the curette. For this purpose it will often be necessary to cast the animal. The actual cautery under certain circumstances may be useful, but it must be carefully employed, or the disease may be aggravated.

Fracture of the sternum, which is rare in horses, was observed by Sand. The horse had run away and fallen violently to the ground. It rose, however, and after galloping a further distance of about 400 yards suddenly fell once more, and immediately died. Death was found to have been due to injury to the internal thoracic artery, which had been torn by a fragment of the sternum. Sand thinks that the horse had fallen on its shoe.

IV.—WOUNDS AND BRUISES OF THE SOFT PARTS OF THE CHEST-WALL.

(1.) WOUNDS OF THE CHEST-WALL WITHOUT PERFORATION.

WOUNDS associated with injury of the sternum have already been discussed, and consideration has now to be given to those of the soft parts; injuries due to collar pressure will be considered elsewhere. Such wounds in horses are caused by collisions with the pole of the carriage, by two animals meeting violently; in the army by lance thrusts, or by falling on uneven hard ground or on the rider's spur. When the injury is on the anterior surface of the chest, the trachea, the great vessels, and the first ribs may be endangered. Injuries to the sides may consist of extensive gashes in the chest and shoulder muscles, or an offending body may force its way between chest-wall and shoulder, severely damaging the larger blood-vessels and nerves.

Thienemann records that a horse, which had received a wound over the elbow and died two days afterwards, had the axillary vein torn through. Hübner describes a case in which the horse fell; a fluctuating swelling immediately appeared, in consequence of rupture of the axillary artery, gradually extended over the neck and chest, and proved fatal forty-five minutes later.

Prognosis depends chiefly on the position and degree of the injury. Wounds involving only the skin and superficial layer of muscle usually heal well, especially if the discharge finds ready exit; but deep-penetrating wounds of the lower border of the neck are very grave;

infection is liable to extend in the loose connective tissue which surrounds the great vessels, the trachea, and œsophagus, and may reach the chest, causing septic pleuritis. Wounds complicated with fracture of the first rib often produce similar results. The great vessels of the neck and the nerves may, moreover, be injured, producing severe or fatal bleeding, respiratory difficulty and cardiac disturbance. Violent shocks to the chest-walls may injure the axillary vessels and nerves and produce paralysis, while similar conditions also occur in fractures of the scapula and humerus. Wounds complicated with fracture of the scapula and humerus are frequently fatal, septicæmia soon appearing in consequence of direct infection of the wound. Coldness and paralysis of the affected limbs point to thrombus formation in the vessels, while paralysis alone suggests injury of nerve stems. Such serious results are, however, in great part prevented by the protection afforded by the stout thoracic fascia. Where the shoulder-joint is not injured, mere muscular wounds often heal well. Even where the wound passes under the shoulder as far as the joint, recovery usually occurs without affecting the movement of the limb.

The lameness is important in forming a **prognosis**: as long as it is not marked, and no symptoms of fever exist, healing may be expected, even where the muscles are extensively lacerated. Danger of pleurisy is not great. The emphysema sometimes occurring in these muscular lesions must not be supposed to depend upon the thorax being perforated; nor must moderate acceleration of breathing, determined by injury of the accessory respiratory muscles, be mistaken for pleurisy.

Treatment. After bleeding has ceased, the wound should be carefully examined to discover its extent and the possible presence in it of foreign bodies, which, if present, should be thoroughly removed. The parts are then cleansed; in deep injuries of the anterior surface of the chest, extending towards the middle line, particular provision must be made for the escape of wound discharges in order to prevent infection of the sternum. It is well to lay open any pockets or make counter openings. Drains or setons are introduced if required. Where larger vessels, especially veins, are exposed, after-bleeding may result during the first three days, but seldom later. It is, therefore, advisable, whenever possible, to ligate injured vessels, to fill large wounds with antiseptic tampons, and carefully to watch the progress of the case. Irrigation with lukewarm antiseptic solutions should be continued for several days (sublimatè 1 in 3,000, carbolic acid 1 in 50). Cold solutions should only be used while bleeding

persists. Where continual irrigation is unattainable, the wound must be rinsed out carefully every hour or two with a disinfectant. Similar methods of examination and checking hæmorrhage are applicable to wounds extending under the shoulder. Provision must be made for free exit of discharge, and incisions, counter openings, &c., combined with effectual irrigation, adopted as above indicated.

(2.) WOUNDS OF THE PLEURA AND THORACIC CAVITY.

Punctured or penetrating wounds of the chest are usually caused by thrusts with the bayonet, lance, or sabre ; in war by projectiles ; by falling on harrow teeth, or on the rider's spur ; in oxen by horn-thrusts, by splinters of wood, or by the aspirating needle used to drain the pleural sac. Such wounds extend through the pleura costalis, and even injure the thoracic or abdominal organs. Besides the dangers of bleeding and infection, such injuries may lead to pneumothorax, hæmothorax, pleurisy, and pneumonia.

(1) **Pneumothorax.** Air may enter the pleural sac either from without, or from the lung. As soon as a considerable wound penetrates the pleura costalis, the distended elastic lung generally collapses, air is drawn in through the opening in the pleural sac, and breathing ceases in the affected portion of lung. The walls of the chest continuing their respiratory movements, however, the air streams outward during expiration, and re-enters during inspiration. Should the opening in the thoracic wall be partly or entirely closed during expiration, emphysema results from the retiring air being forced into the loose connective tissue in the neighbourhood of the wound. Injury to lung or a bronchus also causes pneumothorax, usually attended with severe bleeding and collapse of the affected portion of lung.

Air in the pleural sac is not necessarily fatal, so long as both lungs do not collapse, though in the horse such a complication is to be feared on account of the cribriform structure of the mediastinum behind the heart. It is reabsorbed in a comparatively short time, as has long been known in man ; and more recently been demonstrated in horses by the experiments of Trousseau, Leblanc, and Perosino. Perosino opened the pleural sac in a horse between the 10th and 11th ribs, and allowed air to enter through a tube until the difficulty in breathing threatened death from suffocation ; but, on the evening of the day of experiment, all untoward appearances had vanished. Pneumothorax is, nevertheless, a very grave con-

dition, because infective material, entering with the air, may produce severe inflammation. Air, entering the thorax through wounds, is more apt to be infective than that admitted through the lungs, which is purified as it passes over the respiratory mucous membrane, much in the same way as air entering a bottle may be filtered by a cotton-wool plug. The emphysema in the neighbourhood of chest wounds is usually of little importance.

(2) **Hæmothorax**, or the presence of blood in the pleural sac, arises either from rupture of vessels (intercostal) in the wall of the thorax, or from injury of the lung or heart. Large quantities of blood in the thorax may certainly produce sudden death by compressing the lungs and inducing suffocation; but even a small quantity is dangerous, because organisms may reach it either through the chest wall or lung, and produce septic pleurisy. The simultaneous existence of hæmothorax and pneumothorax accordingly renders prognosis doubly grave.

(3) **Pleurisy** results from the injury, and from the wound becoming infected. It may thus arise either from the external or the lung injury, and will evidently be favoured by foreign bodies remaining in the wound, and by difficulties in carrying out antisepsis. Pneumonia only results in cases where the lung is simultaneously injured, and occasionally happens in cases of complicated fracture of the ribs. Cadéac describes a case of pyothorax in the horse, which was treated by washing out the thorax. During the operation a glass tube about 4 inches in length and $\frac{3}{16}$ inch in diameter slipped into the cavity. Seven ribs were resected, allowing the entire hand to be introduced and even the heart to be felt, near which the glass tube was found. It was removed and the wound healed. On subsequent post-mortem examination the affected half of the lung was found entirely adherent to the pleura costalis; the lung itself was healthy.

Symptoms. In determining whether a penetrating wound of the chest exists, one must not immediately have recourse to probing, nor should one, under any circumstances, proceed to explore with uncleansed fingers. Probing a chest wound is generally condemned, as perforation of the still uninjured pleura costalis may be produced with the probe, and such examination may introduce infective material into the thoracic cavity even where the wound has been carefully cleansed. The question must therefore be answered by first considering the other symptoms. One should make—

(1) An examination of the position and condition of the wound and of the body which has produced it, as well as the method of its

production. This may suffice to indicate whether the chest-wall has been penetrated.

(2) The breathing must be watched. Dyspnœa may be the result of pneumothorax, hæmothorax, or pleurisy, and occasionally in less degree, of injury to the muscles of respiration. Septic pleuritis is associated with high fever. Percussion determines the existence both of pneumothorax and of hæmothorax, and allows of their being distinguished.

(3) Blood-stained discharge from the nose or mouth generally points to injury of the lung, though its absence does not establish the contrary.

(4) The passage of air through the wound during breathing is strong evidence of a penetrating wound of the chest; but, as above stated, entrance of air or emphysema of neighbouring parts, occurs in some non-penetrating wounds of large extent.

(5) Pulmonary prolapse sometimes occurs after large openings in the thoracic wall, and the piece of lung is liable to be strangulated and become necrotic.

(6) If these observations do not determine whether the wound is a penetrating one, and it is considered absolutely necessary to determine the question rather than to leave it uncertain and merely to adopt the treatment usual in penetrating wounds, the parts may be disinfected, and further examined with the aseptic finger or probe. In default of an accurate diagnosis, it is, however, better to adopt the treatment for a penetrating wound. Bleeding vessels should be ligatured, and any fragments of broken ribs removed under antiseptic precautions.

Animals with such wounds sometimes bend the hind-quarters instinctively towards the injured side, and thus prevent the wound gaping.

Prognosis. Every penetrating wound of the chest should be viewed as a possibly fatal injury; infection is almost inevitable, but all do not necessarily take a fatal course. They are more grave in horses than in cattle, but less so in carnivora. The prognosis chiefly depends on whether or not infection exists with pneumothorax or hæmothorax, and pleurisy seems imminent. According to general experience, the risk of pleurisy is greatest in horses. When thoracic wounds are of a serious character, most horses require to be supported in slings, otherwise they sometimes die in two or three days. Incised wounds produced by scythes or lances heal more easily than penetrating bruised wounds made by manure-forks or the tines of harrows. Complications materially affect prognosis; pneumothorax,

hæmothorax, or pleurisy is unfavourable. Moderate fever from wound infection does not necessarily prevent recovery, but symptoms of pleurisy generally forebode death.

Numerous recorded cases testify that such injuries in animals sometimes take an unexpectedly favourable course. Jacobin records the satisfactory recovery of a horse from a penetrating wound caused by a spur, which had perforated the thoracic wall and injured a rib. Recovery is not impossible even in cases in which the finger can be introduced into the pleural cavity, and the movement of the lung distinctly felt. Thus Thierry describes a case of shot-wound, with prolapse of the lung through the thoracic opening, in a sporting dog. Recovery occurred in three days. Esvelt saw a horse whose chest had been penetrated by a carriage pole between the 11th and 12th ribs. There was prolapse of the lung. After reducing this and applying an antiseptic dressing the parts gradually healed.

Noguès, called to see a mare which had been "horned" by a cow, found a mass of lung protruding from a thoracic wound three inches long. The mare was cast, the torn mass of lung ligatured, and a piece, weighing 20 ounces, was removed with a single sweep of the knife. The ligature was afterwards removed, the parts were disinfected, the hair was clipped away, the wound sutured, and a blister applied over all. Recovery occurred without complications.

On the other hand, apparently slight wounds may prove rapidly fatal. This is especially true of insignificant-looking penetrating wounds, like those produced by manure-forks, in which danger of infection occurs during the first three or four days. When pus forms, if meanwhile no threatening symptoms have appeared, the prognosis becomes more favourable.

The principles of treatment are clearly apparent, the first and most important being thorough antisepsis. After checking the flow of blood by ligaturing the injured vessels with sterilised material, the wound is carefully disinfected, and closed. Where much discharge is to be expected, drains must be inserted and counter-incisions made. Over the ordinary dressings an air-tight bandage should be applied. For the larger animals moss wadding is suitable, but where this is not obtainable a cloth folded several times can be substituted, and the compress kept in place with a roller. In small animals, bandages are usually serviceable, but must be renewed immediately they become moist with wound discharge.

Where proper dressings cannot be provided, arrangements may be made for continuous irrigation with disinfectants; but if a penetrating wound exist, care must be taken that fluid and air

do not enter the pleural sac. Sometimes both the dry and moist methods are associated or alternated by allowing disinfecting fluids to pass through the dressing and wound, from whence they are suitably drained. Such irrigation, or frequent moistening with antiseptic solutions, is useful. Dressings must be changed as soon as soaked with discharge, or where high fever has set in. When healthy lung protrudes through the wound it should be reduced; but when the lung is livid, or plainly infected, the protruding portion should be ligatured and excised, and the chest wound carefully closed and protected. Little can be done in combating pneumothorax; and in hæmothorax the blood, being already clotted, is difficult to remove. In septic pleuritis in horses and carnivora the thorax is sometimes washed out with 1 part of corrosive sublimate to 3,000 of water; for ruminants, a solution of 1 in 700 of boric acid, or a lotion of alum. acet. of similar strength may be used. But such treatment is seldom effectual. Weisner, experimenting on two horses with 1 per cent. solution of salicylic acid, was not successful.

V.—SHOULDER ABSCESS.

Two varieties of shoulder abscess have been described, one superficial, presenting similar features to subcutaneous abscesses elsewhere; the other of a special type, almost peculiar to harness horses, always more or less deep-seated, and generally due to botryomycotic infection.

Symptoms and progress. A diffused, hard, slightly painful swelling, as large as a child's head or larger, lying either in or below the mastoido-humeralis muscle (levator humeri) suddenly appears. The skin is sound and movable, marked lameness is seldom present, though sometimes stiffness or slight lameness occurs when the abscess is nearly mature.

For some time no marked changes occur in the swelling, except possibly an increase of circumference, and it may remain stationary for many weeks, during which steady work may be done. Usually after a few weeks, fluctuation appears at the most prominent part, and on incision thick pus is discharged. The earlier the swelling is punctured the more quickly it subsides. If operation is long delayed the walls increase in thickness, and considerable inflammatory fibrous growth remains.

Opinions differ as to the origin of these tumours; Franck believed that they are associated with injury of the prescapular glands. Hertwig, who is supported by Esser, considered that they are caused

by continuous pressure of badly-fitting collars, as indicated by their occurring mainly in draught horses, usually in those drawing heavy loads. Viborg viewed them as complications of strangles. Every practitioner must have seen many draught horses with this shoulder abscess, but riding horses seldom seem to be so affected. Stockfleth, however, reports a case in a horse which had been confined for several months to the stable on account of lameness; but this may be regarded as the exception which proves the rule. It is specially noteworthy that, even from their earliest beginning, these

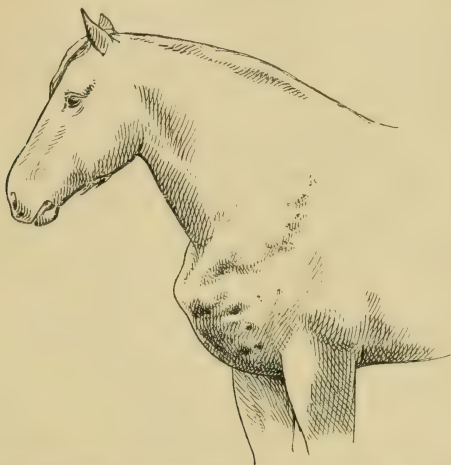


FIG. 385.—Multiple abscess formation in the shoulder-region due to *Botryomyces*.

abscesses contain pus, in which *botryomyces* and pus cocci are almost invariably present. This fact has been amply proved by the large number of these abscesses containing *botryomyces* opened in the Berlin and other clinics during the last few years.

But how does the infection occur? Though it is clear that infection with cocci must be associated with injury caused by the collar, it is by no means clear how the cocci penetrate to the deep-lying seat of abscess through uninjured skin. Cadiot regards this objection as valueless; the skin may and generally does appear intact, yet very slight excoriation permits cocci to penetrate, and by the time the abscess appears, the inoculation lesion will be healed or not discoverable. Fröhner and others considered that the *botryomyces* gains entrance through cutaneous wounds or abrasions

which are too small to attract attention. Schimmel urges that the cocci proceed from the lower portions of the limbs by the lymphatic vessels; and in support of this view adduces the case of a horse which suffered from a suppurating sandcrack, from which discharge of pus was prevented by applying a bandage, when abscess on the shoulder was shortly developed.

In most, if not all cases, the infective agent induces suppurative inflammation of the mastoido-humeralis muscle, and sometimes the prescapular and prepectoral lymphatic glands are also involved.

In many of Möller's cases the disease has started in the prepectoral glands, and shown the character of a lymphadenitis chronica suppurativa. The process either arises in the common mastoido-humeralis muscle, and is of the nature of a suppurative myositis, or the underlying lymph glands are the primary seat of disease, and in such cases it should be described as lymphadenitis suppurativa; while from this, the inflammation extending to the muscles produces a chronic suppurative myositis. Other growths, however, occur here; thus in a grey horse Möller saw a melano-sarcoma, which had been mistaken for abscess on the shoulder, and Günther reports a similar case. The slow development of melano-sarcoma, however, sufficiently differentiates it from the condition now in question. The disease is usually chronic, especially when not treated. Diagnosis seldom offers much difficulty. Shoulder abscess may be distinguished from true tumour by being more rapidly formed, and less sharply defined, and by the inflammatory character of the swelling.

Prognosis is favourable where treatment is early adopted. When delayed, inflammation becomes chronic, firm masses of connective tissue are produced, and when these have existed for months complete extirpation, which is always difficult, is the only remedy; otherwise the swelling is again bruised by the collar and becomes inflamed, leading to further formation of fibrous tissue. Whatever the cause, the earlier the abscess is opened and drained, the more rapid and thorough is resolution. Extirpation of the glands is the only means of dealing with chronic lymphadenitis.

Treatment. Formerly blisters were recommended as the first application, and the abscess was punctured in eight to ten days. Stockfleth inserted the actual cautery into the cavity of the abscess after dividing the skin. Others allow the abscess to mature. Block has recommended the following compound: Ungt. cantharid. off., 30 parts; tinct. cantharid. and tinct. euphorb., of each 15 parts (evaporated to half their bulk); ol. croton. 1·20; hydrarg. biniod.,

4; fresh butter, 30. After clipping the hair and applying the ointment, Block holds a red-hot iron a short distance from the skin so as to heat it. The animal is then fastened up for three days. The best treatment is immediately to open the abscess and evacuate the contents. The abscess sometimes lies as much as 4 inches below the surface, but this should not prevent operation. By thrusting the knife towards the centre of the swelling dangerous bleeding is avoided and the abscess opened with certainty. As in other such operations, the hair is removed, the skin cleansed, the position of the swelling determined by palpation, and the horse twitched.

A pointed bistoury, with its cutting edge directed upwards, is inserted from 2 to 3 inches. The pus usually then discharges; but if not, a stout probe is introduced, the fluctuation localised, and the wall of the abscess punctured with either knife or probe. After discharge of the pus, the swelling should be laid open in its entire length, if possible, by a vertical incision, thus completely exposing the cavity of the abscess, which is then freely curetted and disinfected. Bleeding may be checked by means of tampons, or the cautery.

To promote dispersal of the swelling, moist warm applications, frequently renewed, are employed for eight to fourteen days; they are kept in position with a cloth doubled two or three times, and fastened to the neck by a bandage. Jacobs punctured the abscess with a trocar, and injected 2 per cent. lysol solution, followed by Lugol's solution of iodine. In one case the abscess could not be found. Lugol's solution was injected three times in eight days, and healing occurred. Schmidt recommended the injection into the swelling of a saturated solution of common salt. Active suppuration and perforation are said to follow; but a case treated in this way by Schilling soon afterwards died from gangrene. Injection of common salt certainly promotes suppuration, especially if not sterilised, but as it possesses the disadvantage of exposing the animal to grave infection the use of the knife is always preferable.

Where these abscesses have existed for several weeks, and contain no large cavity, extirpation becomes necessary. This may be either (1) partial, which is only adopted where no sharp margin divides the swelling from the sound textures, and is seldom effectual; or (2) total, which is specially indicated when the duration of the case has been considerable, and there is hence no prospect of disappearance of the swelling after opening. In most cases free opening of the abscess cavity is sufficient, as above mentioned. In old growths as much as possible of the anterior part should be removed. Some

operators practise local anæsthesia by Schleich's method ; Malkmus applies a twitch and the hippo-lasso. Bayer recommends strict antiseptic precautions, and after carefully curetting and disinfecting the abscess cavity applies a dressing which is fixed to the button sutures used to close the wound. Malkmus has shown that these excessive precautions are unnecessary, and that by using interrupted sutures, inserting a drainage-tube, and dressing with glutol, the same end is attained. He also insists, however, on the importance of curetting the cavity and of observing antiseptic precautions. The horse is afterwards kept for a fortnight on the pillar reins, and if great swelling occurs the parts are kept moist with 3 per cent. solution of acetate of alumina. If the covering of glutol separates from the surface of the wound it is renewed ; in a week the drainage-tube is removed, and in eleven days the sutures. The operative wound usually heals by primary intention in three weeks, and the horse can resume work in one to two weeks later. This method can be recommended as practical and efficacious.

Before attempting total extirpation the horse should be cast and anæsthetised, for even if quiet, bleeding or other complication may ensue, which cannot be properly dealt with if he is standing or struggling. The animal is laid on the healthy side, placed in a good light, and the hair removed from the swelling. Scalpels, forcipressure forceps, needles, thick and thin ligatures, and aseptic cotton wool, or gauze must be provided. An incision is made in the direction of the neck over the tumour ; the skin on either side is separated or drawn back, which, on account of the looseness of the subcutis, is not difficult. In order to exert traction on the tumour, a piece of tape is passed through it, and the loose connective tissue surrounding it is separated with the fingers or scissors, beginning at the lower and inner side in order to avoid the carotid and its branches, or in case of injury, to facilitate their being ligatured. Profuse bleeding may occur if the swelling is deeply incised, or a portion of it is allowed to remain. Divided vessels sometimes retract into the masses of connective tissue, their ligation becomes difficult or impossible ; and as the actual cautery often belies its reputation, the operator may see the animal bleed to death. This danger is avoided if the operator carefully detaches the growth as far as possible with scissors or the fingers, and in dividing the muscle at once ligatures the exposed vessels in two places. The tumour secured, if necessary, with a strong tape, is then cut away. After rinsing out the cavity with a disinfecting fluid, and ligaturing any bleeding vessels, the surfaces should be powdered with 1 part of iodoform to 3 of tannin, the cavity

lightly stuffed with gauze or cotton wool, a drain inserted, the wound sutured, and the animal allowed to rise.

In twenty-four hours the sutures may be loosened and the wound rinsed out with sublimate solution. Dressing with iodoform and tannin is persevered with. To prevent interference with the wound, the animal should be placed on the pillar reins, or a side-stick applied in the recognised manner. After a few days a dry black scab covers the surface of the wound, and, if it become loose in spots, should be removed and the antiseptic powder reapplied. Towards the edges of the wound a small quantity of discharge may appear, which can be removed with cotton wool and the surface again powdered with iodoform and tannin. During the first six days the wound shows no marked change under this treatment, but gradually becomes smaller, and in about three or four weeks the cavity will have completely filled up.

An abscess of the shoulder, extirpated on July 16th, left behind a cavity 7 inches long, 4 inches broad, and $2\frac{3}{4}$ inches deep. Until the 22nd no marked change had occurred, but subsequently the dimensions were reduced as follows :—

Day.	Length.	Breadth.	Depth.
July 23.	$6\frac{1}{2}$ inches.	$3\frac{1}{2}$ inches.	$2\frac{1}{4}$ inches.
„ 24.	$6\frac{3}{8}$ „	$3\frac{1}{8}$ „	$2\frac{1}{8}$ „
„ 25.	$6\frac{1}{8}$ „	$2\frac{7}{8}$ „	2 „
„ 26.	5 „	$2\frac{1}{4}$ „	2 „
„ 27.	$4\frac{3}{4}$ „	$2\frac{5}{8}$ „	$1\frac{7}{8}$ „
„ 30.	$3\frac{7}{8}$ „	$1\frac{7}{8}$ „	$1\frac{3}{4}$ „
„ 31.	$3\frac{3}{4}$ „	$1\frac{3}{4}$ „	$1\frac{5}{8}$ „

In such cases open wound treatment is not only the quickest, but the most convenient. When a dry scab is produced over the entire wound nothing further is necessary.

VI.—SADDLE AND COLLAR GALLS—INJURIES FROM PRESSURE— FISTULOUS WITHERS.

THE saddle and collar exercise heavy pressure on the tissues below, and may produce injuries to the skin or subjacent textures. These are usually of the nature of bruises, seldom of excoriations ; and as those produced by the saddle possess the greater interest, they will be first considered.

(1.) INJURIES PRODUCED BY THE SADDLE— SADDLE-GALLS.

To prevent the pressure of the saddle injuring the back, the following precautions must be observed :—(1) Pressure should be dis-

tributed as evenly, and over as large a surface, as possible. (2) Pressure must be confined to parts fitted to bear it. (3) Those portions of the saddle which bear on the body must be properly stuffed, or the back covered with a folded rug, &c. Weight can only be borne where muscles or fat underlie the skin, as is the case along both sides of the vertebral column in the dorsal region.

In the middle line of the back and on the withers, where the bones are not cushioned, any considerable pressure causes bruising. Saddles are, therefore, made to bear on the protected parts only.

The anatomy of that portion of the horse's back carrying the saddle may be briefly described as follows (Fig. 386):—

(A) In the middle line of the withers and back, under and closely

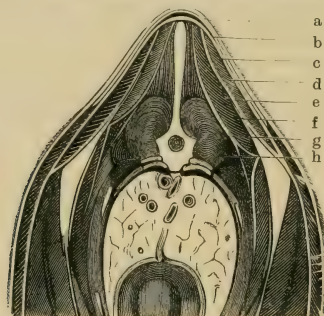


FIG. 386. —Transverse section through horse's thorax (semi-diagrammatic, after Franck). *a*, Skin; *b*, fascia of panniculus; *c*, dorsal fascia; *d*, muscular layers; *e*, external fascia of withers; *f*, muscular layers; *g*, subscapular fascia.

adherent to the skin (*a*), lies the fascia of the dorsal panniculus (*b*). Below it extends the dorsal fascia (*c*), which is applied closely to the termination of the ligamentum nuchæ, covering the superior spinous processes of the 5th—10th dorsal vertebræ (*d*). This is not covered with muscular padding.

(B) On either side of the vertebral column, in the “saddle-bed,” or surface on which the saddle rests, the skin is provided with a strongly developed subcutis, and covers the fascia of the dorsal panniculus (*b*), which is attached by loose connective-tissue to the dorsal fascia (*c*). Below this lies a pad of muscle, comprising the latissimus and longissimus dorsi, the spinalis and semispinalis dorsi, the trapezius, rhomboideus posterior and the ilio-costalis (retractor costæ) muscles.

Injuries to the saddle-bed occur most frequently from irregularly distributed pressure continued for a considerable time. Limited

areas of skin are compressed, leading to vascular distension and rupture; but while pressure continues little extravasation occurs. So soon, however, as the saddle is taken off, blood and lymph pass from the ruptured vessels into the perivascular spaces. As in other bruises, if the skin were not pigmented, reddening might be noticed. At first a serous fluid accumulates in the interstices of the cutaneous tissue, and at a later stage, more and more white corpuscles appear, with plastic infiltration. The gall consists of a circumscribed firm swelling, caused by extravasation into and infiltration of the cutis. It may be soft, occasionally fluctuating, and without sharp borders, as when blood and lymph are freely poured into the loose subcutis. Should this condition develop under the fascia, the swelling is less sharply defined and more tense.

The lesion, when situated on the withers or spine and caused, as indicated, by bruising of the skin covering the superior processes of the vertebræ is less sharply defined, more dispersed, and often shows fluctuation. Although it may not be painful at first, it becomes so if the vertebræ are injured. While lesions of the withers and spine are generally subcutaneous, those of the saddle-bed are generally cutaneous. From pressure and friction of the girths and other parts of the harness, hair and epidermis are often rubbed off. If bruising also occurs, cutaneous swelling ensues. The condition is one of cutaneous or subcutaneous bruising, which sometimes consists in rupture of the tissues and smaller vessels, less frequently in injury of larger vessels and consequent extravasation.

Symptoms. Saddle-galls are best discovered half an hour to one hour after unsaddling; it usually takes this time for their appearance. They generally vary in size from a sixpence to a five-shilling piece; are tense, hard, somewhat painful, warm, and sharply margined. The larger are always flat. Should the hair over the saddle-bed be wet, these points of pressure dry first, producing isolated dry spots. Not infrequently they are itchy, and the animal bites or rubs them. Bruises of the subcutis are diffuse, sometimes œdematous, sometimes fluctuating, and are usually more painful, especially on pressure. Saddle-galls are best detected by passing the hand over the withers, spine, and the saddle-bed, when thickening, firmness, or tenderness may be discovered. When the tender spot is touched or pressed the animals bend the back or move away. This is specially noteworthy in the region of the withers, for the detection of such swellings in this site is otherwise somewhat difficult.

Disease implicating the ligamentum nuchæ is characterised by

great swelling and profuse pus formation, swelling of the neighbouring lymph vessels, and of those on the shoulder and over the ribs. Suppuration with necrosis in the depths is indicated by exuberant, flabby, dark-red granulations, which bleed easily; whilst implication of the superior spinous processes is shown by firm swelling and the greater degree of pain. Necrosis of these processes, or of the cartilage covering them, can often be detected by palpation. Where the skin has become necrotic, it is hard and leather-like, and the hairs on the affected spot are usually erect. Excoriations produced by rubbing are easily seen.

Course. Where extravasation has been slight, cutaneous swellings usually disperse rapidly. The extravasate poured into the interstices of the cutis is reabsorbed, and the damaged tissue undergoes repair. The *status quo ante* is thus restored. Proper treatment may remove such a swelling within a few days; but, as formed elements gradually replace the earlier infiltration of blood or serum, the longer such swellings have existed the longer will be the time occupied in their removal.

Subcutaneous extravasations of blood or lymph do not become absorbed so rapidly, and frequently last eight to fourteen days or longer. The larger the fluctuating swelling, the longer it persists. Sub-fascial extravasations are still more tedious, and hence those on the withers are always more difficult of removal than those on the saddle-bed.

Cutaneous swellings are frequently followed by necrosis of the skin. Owing to defective local nutrition, it is most common on the site of old cicatrices, and also where the surfaces, while still tender, are again subjected to severe pressure. The living processes are thus arrested, the fluids are to a great extent pressed out of the tissues and vessels, and limited necrosis results. When this occurs, demarcation generally takes two to three weeks, sometimes even longer; it is first completed in the loose subcutis, later in the corium.

The third termination is suppuration: it seldom occurs in the cutaneous swellings, but is common in the subcutaneous, especially in those associated with extensive extravasation. Suppuration is met with when the skin is infected as well as bruised, and often after the knife has been unnecessarily used. Pus formation may lead to necrosis of the neighbouring fascia, of the ligamentum nuchæ, and even of the superior spinous processes, producing fistulous withers. Infection and burrowing suppuration excite inflammation, which increases the difficulty of free discharge, brings about a *circulus vitiosus*, and greatly delays recovery. Hübner, during such a case

affecting the occiput and the shoulder, counted 200 abscesses, from the size of peas to that of a child's head.

In severe injuries, like bruising of the skin and soft parts and crushing of the spinous processes, diffused suppuration and lymphangitis are liable to ensue as complications, sometimes spreading in the subcutis, and not infrequently also under the fascia. Necrosis of the ligamentum nuchæ, of the superior spinous processes, and even of the deeper portions of the vertebræ may occur, and in exceptional cases necrosis of the ribs and of the shoulder-blade is seen.

The above conditions must not be confounded with certain forms of eczema, which are particularly apt to attack riding horses in regions where there is much chalk dust. They affect the back, especially behind the saddle-bed, but the extent of surface involved, the trifling amount of swelling, and the thick scurf formed sufficiently differentiate them.

In a case described by Möller, pus formation had extended along the fascia of the back as far as the pelvis, producing necrosis, and also invaded the under surface of the longissimus dorsi, separating the latter to a great extent from the ribs. Several ribs afterwards became necrotic. Pus also appeared under the serratus anticus major muscle.

The prognosis depends on various factors. It is modified by—

(1) The position of the swelling. The cutaneous is more hopeful than the subcutaneous, especially if situated in the withers.

(2) The duration of the swelling. The longer swelling has existed, and the harder and more resistant it appears, the further has infiltration proceeded, and the more tardy will be resolution. Fistulous withers of long standing is usually difficult of cure.

(3) Cellulitis or lymphangitis adds to the gravity of the case. The condition is of little gravity provided it remain aseptic; the occurrence of suppuration renders it serious, and doubly so if the withers be the part involved.

(4) In prognosing fistulous withers, particular note must be taken of the degree of swelling and pain, and the amount of pus. Swelling indicates extension of suppuration, if the discharge takes place only on pressure from without, or during movements of the animal. Intense pain points to injury of the superior spinous processes.

Causes. Certain horses suffer more than others, depending on greater vulnerability of the skin, or on the presence of cicatrices or scabs, or on peculiarities in form interfering with the fitting of the saddle. Amongst these may be included abnormally high, low,

or short withers, flatness of the ribs, keel-shaped breast and short sternum, and distension of the abdomen, causing the girth to slip easily forwards. Old horses sometimes have the muscles in the saddle-bed atrophied, and are therefore more liable to contract saddle-galls. Vicious, irritable, and restless horses which cannot be carefully saddled often suffer, as also do those which have irregular action. Lamé horses frequently have saddle-galls, especially on the withers, on account of the unequal incidence of the body-weight shifting the saddle towards the side of the sound foot. Saddle-galls are often caused by horses sweating profusely, or by the skin being soaked in rainy weather. The mechanical causes may be divided into three groups—

(1) Faulty construction of the saddle. The best preventer of saddle-galls is a skilful and careful saddler. Though it appears easy in principle to distribute the pressure equally over the largest possible surface, in practice it is really very difficult. The saddle must be neither too narrow nor too wide, and provision must be made for changes in the condition of the animal. A saddle, when too wide, endangers the withers; when too narrow, it bruises the bodies of the ribs with the outer edges of the bearers. The front portion must conform to the height of the withers, which are injured if it be too low. Fractures or bends in the bearers or branches of the saddle-tree, badly-stuffed panels, or repeated soaking of them, easily lead to saddle-galls. Parts of the saddle or collar, which do not fit closely to the body of the animal, sometimes produce skin excoriations.

(2) Faults in saddling or in putting on the collar. Folds or foreign bodies in the padding, however small, often produce bruises. The padding, if it shifts upwards, may injure the withers. The practice of applying the saddle-blanket so that it shall be pushed slightly backwards when the saddle is placed in position is recommended, because the hair of the saddle-bed will thus be smoothed in its proper direction. The saddle, if too far forward, may directly bruise the withers; if too far back, it works forward, the girth becoming loose and easily causing bruises. Loose girths, and irregular tightening of the component parts of the girth in the German saddle, also give rise to saddle-galls.

(3) Errors in riding. An awkward position in the saddle, sleeping on horseback, and continual shifting forward, displacement of the saddle in mounting, and injudicious riding, are frequent causes of injury. These injurious influences must, however, be in operation some considerable period before serious saddle-galls are produced; they seldom result from short excursions.

Treatment. To prevent the condition, general experience suggests leaving the saddle on for half to one hour after dismounting. Where an injury has taken place, the vessels are compressed and almost bloodless. If pressure be now suddenly and completely removed, blood is vigorously forced into the paralysed vessels, and may thus rupture their walls. On the other hand, if the saddle is allowed to remain some time in position, circulation is gradually restored without injury. The fact that the swelling first appears after removal of the saddle supports this explanation.

In cutaneous swellings further extravasation is most surely checked by cold, which causes the vessels to contract; while reabsorption of extravasation which has already taken place, is most favoured by moist warmth. The use of cold is indicated in fresh cases—that is, in those seen immediately after the appearance of the swelling. In twelve to twenty-four hours, on the other hand, moist warmth deserves preference; and, where cold cannot be carefully and continuously applied, Preisnitz's poultices should be employed. The use of cold may be associated with gradual slight pressure, or, even better, with massage. A cloth folded several times, or a bag filled with little pieces of ice, is very useful in fresh cases. The old practice of binding a flat stone on the swelling leads to necrosis of the skin; the application of a turf soils the back, and thus predisposes to new bruises. Massage, in the form of gentle stroking with the fingers, greatly hastens reabsorption. Most cutaneous swellings of recent appearance can be removed in twelve to twenty-four hours by cold, associated with massage. When of longer standing, moist warmth in the form of Preisnitz's poultices deserves preference, and can be assisted by massage. Where necrosis does not result, this method of treatment always succeeds. Tincture of arnica, often used, has no effect; even its antiseptic properties are nullified on account of the excessive dilution to which it is generally subjected.

Where necrosis has appeared, separation of the dead portions is facilitated by Preisnitz's poultices, or moist warmth. Portions of necrotic skin should be dissected away or removed with dressing forceps. Removal of the necrotic piece of skin does not greatly assist healing, because the line of dissection seldom coincides exactly with the division between living and dead tissue. After separation of the piece of skin, the wound is gradually filled up by granulations. The general principles of asepsis must be strictly enforced. As soon as a dry scab has formed, interference should be avoided. Where the wound has filled up, cicatrization is well advanced, and the neighbouring swelling has disappeared, the saddle may again be

used, with such precautions as a smooth piece of waxed linen sewed into the flaps, where they overlie the damaged spot. Where a felt numnah is used, a piece corresponding in size and position to the injury may be cut out; where a padded saddle is in use, a portion of the padding can be withdrawn. This protects the tender surface while it is denuded of hair and only covered with a thin epidermis.

Injuries to the withers, particularly those complicated with exudation and extravasation into the subcutis, require quite different treatment. In fresh cases cold is useful, but without pressure and without massage. Any considerable pressure usually causes pain, while massage favours further bleeding into the subcutis. After twenty-four hours, moist warmth is to be preferred. To prevent infection and pus formation, an antiseptic can be added to the compresses, which may be prepared with 1 per 1,000 sublimate solution. Where the tenderness is less, and large hæmatomata exist, massage may later be used. Artificial removal of the contents may here be recommended, using a Pravaz's syringe, though antiseptic precautions must in such case be very carefully observed. Both the skin and instrument must first be disinfected; and, after removal of the extravasation, moderate pressure should be maintained by means of antiseptic dressings to prevent recurrence. Particular care is required in using the knife, and fluctuating swellings must only be opened when it is quite clear that pus exists. It is preferable, in doubtful cases, to employ a blister of cantharides, or biniodide of mercury, by which a swelling is caused and moderate pressure produced on the extravasated material, bringing about resorption.

Pus formation in the region of the withers renders treatment very difficult. Removal of pus and necrotic material, and prevention of fresh infection and necrosis are the chief objects to be sought in these cases. The knife must often be used freely. Sinuses should, if possible, be laid open to their extremity, pockets exposed, and necrotic pieces of lig. nuchæ, of fascia and of superior spinous processes removed as soon as possible. Gauze or rubber drains assist the escape of the discharge, and prevent further extension of infection. In the event of pus forming beneath the muscles, these are laid open, but care must be taken not to divide the skin crosswise over the middle line of the back, because in this way wounds result, which heal with difficulty on account of tension or of their edges turning inwards. Sometimes suppuration extends to the muscular tissue of the neck, which must then be laid open, usually as deeply as the lig. nuchæ, which, as in poll-evil, may require to be partly excised. In such exceptional cases Hertwig and many others recommend

dividing the ligament an inch or two in front of the necrotic portion (*desmotomie cervicale*). A mass of new tissue forms at this point, constituting a barrier to the further forward spread of necrosis. Once this is produced the sinus is freely laid open, and all the necrotic portions of the ligament behind the cicatricial tissue removed.

The greatest difficulty is experienced where necrosis has attacked the superior spinous processes of the vertebræ. Separation takes a long time, and during this process new pockets may form and fresh structures become necrotic. Should the diseased parts be removed with the curette or saw, further necrosis usually occurs on the surface of the bones, so that with this operation no progress is made. Removal of the diseased spinous processes is only successful where permanent irrigation can be provided and perfect asepsis attained; but, in such cases, the results are often highly satisfactory. Unfortunately the inflammation and pus formation only occasionally allow of this. Good recoveries can only be expected where pus formation has almost entirely disappeared, and where no marked swelling exists.

Cadiot and Dollar describe a case of fistulous withers complicated with necrosis of the supra-spinous ligament, and at a later stage with necrosis of the ligamentous tissue covering the sides of the superior spinous process of the third dorsal vertebra. The necrotic parts were removed with the bistoury and curette, and the wound dressed with creolin, and at later stages with iodine tincture and iodoform. Progress was very slow, and supplementary operations became necessary. Spraying with warm creolin solution, followed by dressing with traumatol, finally proved successful, but the case lasted between four and five months. ("Clinical Veterinary Medicine and Surgery.")

Still graver is pus formation under the shoulder blade. In such cases necrosis of the scapula and its cartilage readily occurs and great difficulty is found in effecting the escape of pus. Suppuration may extend to the inner surface of the scapula and the fascia of the serrati muscles, and the disease thus become further removed from the possibility of direct treatment. In such cases counter openings at the posterior border of the scapula, trephining the scapula, and the insertion of drainage-tubes, may be tried, though such treatment often fails. Portal removed the entire cartilage of prolongation of the scapula through a V-shaped incision, the point of the V being above. A portion of the upper margin of the scapula was also removed. Several divided arteries were ligatured. The wound was dressed for three weeks with Villat's solution, and for a fortnight with Rabel's solution; cicatrization was then complete. Such success is, however, exceptional.

In bruises of the withers, inflammatory disease of the bursa mucosa lying on the superior spinous processes of the 5th to 7th cervical vertebrae, may occur. In such cases a flat fluctuating swelling appears on the withers close to the middle line, sometimes on one, sometimes on both sides; often attains the size of a small cheese-plate, and is attended by moderately developed symptoms of inflammation. The condition consists of bursitis with more or less extravasation into the bursa, and may be easily mistaken for an abscess. Its slow progress distinguishes it from hæmatoma, which usually develops rapidly. It is easier, but more dangerous, to regard it as an abscess, because incision always leads to infection with pus formation, which it is desirable to avoid. Should difficulty occur in diagnosis, an exploratory puncture may be made under antiseptic precautions. After carefully disinfecting the skin, a sterilised needle or an exploratory trocar may be used. Should serum or blood alone be discharged, it is clear that the case is one of bursitis or hæmatoma. After removing the contents, compresses should be applied to keep up moderate pressure on the part, and prevent recurrence of the exudation; while to avoid infection, disinfectants are used in the dressings. Where these cannot be applied, infriktion with sublimate ointment (1 to 18) may be adopted.

Excoriations of the skin must be carefully cleansed, and the surface powdered with iodoform conjoined with tannin or starch flour, or smeared with a neutral fat or ointment. The latter should be applied when swelling attends the excoriation, and after applying the fat or ointment, either cold or Preisnitz's poultices may be used. When such places have healed, the skin should be frequently doused with alcohol, which hardens the skin, and the collar must be provided with a soft covering or a small piece of waxed cloth, in order to prevent further injury. The active movements of the muscles of the skin sometimes prevent the healing of surface injuries. This occurs especially in summer, when flies abound. In such cases the application of weak blistering ointment in the neighbourhood of the affected spot is of excellent service.

(2.) BRUISES PRODUCED BY THE COLLAR OR OTHER PORTIONS OF THE HARNESS.

The horse collar consists of the housing, the two limbs, usually formed of iron, the padding, and the upper and lower open groove. The collar must lie parallel with the scapula without touching it, which it is apt to do if too wide, producing excoriation of the skin

over the scapular region. Most frequently the upper groove causes injury ; if too narrow it bruises, if too wide the skin is rubbed. As a rule, when the collar is in position, there should be sufficient room to allow of the hand passing between it and the withers. The collar, besides, must be wide enough to be easily pushed over the horse's head, and, moreover, fit the shoulder, so that it is neither pushed towards the left nor right.

Injuries caused by the collar are in all essentials similar to those caused by the saddle. Those in the neck region have the same significance as injuries to the withers, that is, they are only grave when the subcutis is injured. As long as the swelling is movable and remains sharply defined, the cutis alone has been damaged. In diffuse swellings infection easily extends to the lig. nuchæ, producing cellular inflammation, necrosis, and pus formation above the cervical vertebræ—a condition which offers great difficulty in treatment. This is particularly true of necrosis of the membraniform portion of the lig. nuchæ. Such diseases are always obstinate, sometimes incurable, because septic cellulitis, set up between the muscles of the neck, leads to abscess formation, and renders it impossible to make satisfactory counter openings for exit of pus. Extensive swelling and profuse pus formation are amongst the gravest symptoms.

Treatment must be based on the same principles as are laid down for fistulous withers. The skin must not be divided transversely across the top of the neck, but the lateral surfaces need not be spared, and suppurating muscles must be freely laid open. Cutaneous swellings produced by collar pressure are to be diagnosed and treated in the same way as similar injuries caused by the saddle.

The injuries produced by traces, tail straps, girths, and surcingles usually consist of excoriations of the skin, are caused by the harness not fitting accurately and, during the animal's work, moving continually over the surface of the skin, and so rubbing off hair and epidermis. Such injuries are naturally favoured by a hard and rough condition of the harness. To protect the injured spots, the portions of the harness causing the injury should be covered with smooth waxed linen, which is preferable to hare or rabbit skin, sometimes used.

In cattle similar injuries are caused at the upper part of the neck by the collar or yoke. The diagnosis and treatment must be as above indicated. In those animals deep-seated suppuration occurs in the region of the poll, giving rise to intermuscular inflammation and sometimes producing conditions which are very difficult to treat. Bruises on the head in cattle are also caused by yokes, especially

if the horns are placed low, or the forehead is markedly convex. Such inflammatory processes readily extend to the periosteum, lead to necrosis of the frontal bone, and may extend to the horn core, producing loosening and loss of the horns. Swelling, increased warmth, and pain occur to a varying extent and degree. The prognosis, however, is usually favourable, if the animals can be laid off work for some time. As to treatment, the general principles of surgery must be pursued. Necrotic bone and loosened horns are to be removed, and the spread of inflammation checked by antiseptics.

VII.—TUMOURS OF THE BREAST.

IN draught horses, tumours occur in and under the skin, chiefly from friction of the collar. They are either single or multiple, and may attain considerable size. Those in grey horses are generally melanotic; in horses of other colours they may result from infection with botryomyces, staphylococci, and other pyogenic cocci, sometimes introduced by dirty collars. Wilhelm found enlargements in the skin of the breast, each containing a small pus centre. They had been treated with iodine and preparations of mercury without effect. Pflug has lately described certain diseased processes of the skin of the shoulder as tylomata. The cut surface in recent cases often appears oedematous, and on casual examination may easily be mistaken for a myxomatous growth; the older swellings are firm and hard (tylomata fibrosa, Pflug). Nor is it astonishing that new growths often rise from the cutis or subcutis, considering the chances of infection here on account of the epidermis below the collar being macerated and not infrequently injured. Many horses in the same stable have been seen to suffer from this disease, the tumours appearing under the collar and producing inflammatory swellings from bruising. In horses, local centres of suppurative inflammation occur in the shoulders, forming little nodules. They originate in the sebaceous and hair glands, and are commonest during warm weather. If they remain unnoticed and the animals be kept at work, inflammation spreads and abscesses form in the site of the glands.

Prognosis of such enlargements depends on their extent and position, usually determined by careful palpation. Small tumours are extirpated with the scissors, large with the knife; when taken in hand early, recovery is usually complete, although recurrence is not infrequent. If the neglected swelling attains a considerable size, possesses a broad base, or extends to the pre-scapular lymphatic

glands, removal is more difficult. When convinced that these glands were implicated, Möller has repeatedly excised them without particular trouble or danger. The "heat bumps" require the animal to be kept from work, or the collar to be eased. Moist warmth favours their subsidence. Those suppurating must be opened early and thoroughly disinfected.

VIII.—TAPPING THE CHEST (PARACENTESIS THORACIS).

THIS operation, practised in man since the earliest times, was first introduced into veterinary surgery by Lafosse in 1772. It is adopted to remove fluid, especially pleuritic effusion, seldom to get rid of air. The diagnosis of such conditions is explained in the text-books on special pathology, and can usually be determined without the explorateur. In detecting empyema, however, the exploring needle is serviceable. Pleuritic effusions compress the lungs and diaphragm, and, interfering with respiratory movements, and the heart and great vessels, impair circulation. Tapping relieves these untoward conditions, but does not always arrest outpouring of fluid or save life. Hence the operation is sometimes regarded as an experiment, though it is often performed. Its timely adoption is frequently useful in hydrothorax following acute pleurisy, though seldom in cases of empyema. No permanent benefit results from removing blood from the pleural sac, because if the membrane is not seriously diseased absorption rapidly occurs. In perforating wounds of the chest, the early injection of antiseptics and performance of paracentesis may sometimes prevent injurious effects from decomposition of the exudate.

(1.) PUNCTURE OF THE THORAX FOR REMOVAL OF PLEURITIC EXUDATE.—The trocar used for the larger animals has a diameter of $\frac{1}{4}$ inch; but one of smaller calibre is usually preferable. Side openings in the cannula are not of particular value. Various precautions require to be observed:—

- (1) Carefully disinfect the instrument and site of operation.
- (2) Prevent entrance of air into the thorax.
- (3) Remove contents slowly, to minimise interference with circulation.

The patient, if possible, should stand, as the recumbent position only adds to the difficulty of the operation. This applies equally to the smaller animals, especially if there is much dyspnoea. Dogs with hydrothorax sometimes die in a few minutes from being placed

on the side. The operation is not now performed as low down as formerly. In all animals the opening should be made either slightly above or slightly below the subcutaneous thoracic vein, keeping clear of the large pectoral muscle, which lies still lower. The upper position deserves preference. Where both pleural sacs contain fluid, the operation should be performed on the right side, to prevent injuring the heart. Sometimes, however, the foramina of the posterior mediastinum are blocked, and it becomes necessary to puncture both sides of the chest. The vertical boundary for punctures lies in the horse between the 5th and 8th ribs; in oxen, between the 6th and 8th; in swine, between the 7th and 9th; and in carnivora, between the 5th and 8th. In actual practice the ribs are often disregarded, and in the horse the puncture is made a span behind the point of the elbow. The instrument should be inserted close to the anterior edge of the posterior rib of the selected intercostal space. (For relations of the ribs to thoracic contents, see Figs. 410 and 411.)

The hair is first shaved from the site of operation, the skin washed with soap and rinsed with ether, and finally saturated with a disinfecting fluid. Similar care must be taken in disinfecting the trocar. In practice this is most easily and safely effected by boiling the instrument in water, or laying it in a 3 to 5 per cent. solution of carbolic acid. To facilitate the entrance of the instrument an incision may first be made through the skin with a bistoury or lancet. The trocar, grasped with the handle in the hollow of the right hand, is supported with the thumb and fingers, while the index finger, more or less extended, is fixed on the cannula at the point to which the trocar is to enter. This distance varies according to the thickness of the thoracic wall, and in the larger animals varies from $1\frac{1}{8}$ to $2\frac{1}{4}$ inches. The trocar is introduced perpendicularly to the chest-wall—until the index finger meets the skin. To prevent entrance of air the skin should be pulled forward or backward before the puncture is made. The stilette is then withdrawn with the right hand, whilst the left supports the cannula, and the left index finger is held ready to close the opening against entrance of air, which may occur when the flow of fluid ceases, when inspiration is specially deep, or when coughing ensues. If the discharge of fluid is prematurely checked by clots of lymph or blood, or by apposition of the lung, a few slight lateral movements should be made with the cannula, and the stilette or a carefully-disinfected probe passed through it.

Schuh has devised a trocar, carrying at its outer end a reservoir (trough or bath), so that the opening of the cannula is always immersed in fluid; but this arrangement is not reliable, and is little

used. The so-called aspirator (Fig. 387) consists of a rubber tube, hollow needle, and large syringe provided with a two-way tap. The hollow needle is inserted into the chest, the piston raised, and when the syringe has become full, the exit cock is opened, and the contents discharged. The process is then repeated. The aspirator, however, has been little used in veterinary surgery. The same object is more easily attained by pushing one end of a suitable rubber tube over

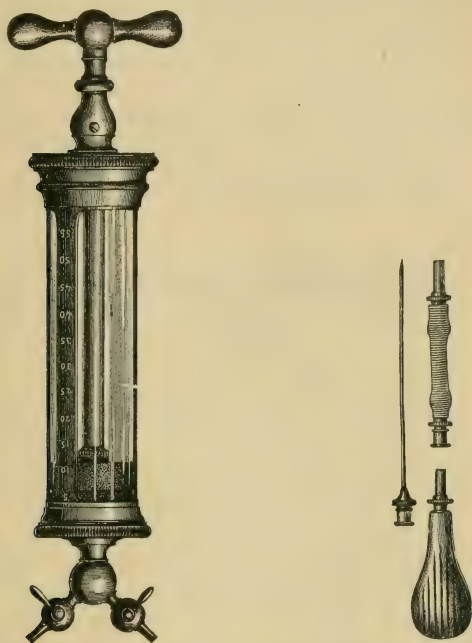


FIG. 387.—Dieulafoy's aspirator, with handle for introducing the needle and flexible connection for syringe.

the free opening of the cannula, and dropping the other end into water. This syphon-like arrangement exerts an aspirating action on the contents of the thorax, but has the disadvantage that the outflow cannot be exactly controlled, while forcible aspiration may rupture pleural vessels.

While using the ordinary instrument, if it be required to check the outflow of fluid, and especially if excitability, dyspnœa, and coughing set in, the trocar must be removed. The necessity of

removing pleuritic effusion gradually, points to the use of trocars of moderate calibre. In carnivora, and to a less extent in horses and oxen, rapid discharge of large quantities of fluid is liable to produce sudden changes of intra-thoracic pressure, determining grave disturbance of circulation, which may occasion not only fresh exudation, but pulmonary bleeding, syncope, or even sudden death. The danger is greatest in left-side effusion, by which the heart has been pushed towards the right side. Frequently, in horses, the whole of the fluid is removed at one operation, and if the chest refills the operation is repeated. Some practitioners advise removing only 10 to 15 pints at one time, and a further quantity some hours later, or on the following day. From the position of the tapping, the complete evacuation of the pleural sac is impossible; but even if it were possible, as already pointed out, it would not be desirable. In too many cases further effusion soon takes place. When sufficient fluid is

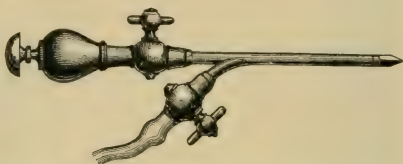


FIG. 388.—Special trocar and cannula. The second limb is provided with a long rubber tube, allowing the instrument to be used as an aspirator.

believed to have been removed, the stilette, previously cleansed, is again introduced, and the cannula carefully removed, the wound rinsed with a disinfectant, powdered with iodoform, and closed with wound gelatine, or collodion, or a suture may be inserted. The benefits of paracentesis mainly result from its modifying intra-thoracic pressure, relieving compression of the lungs, and improving conditions for absorption.

Thoracic puncture for empyema, or for abscess in the lungs, is not often employed, and rarely proves successful. The procedure is the same as for pleuritic effusion, particular attention being paid to antiseptic precautions. Exploratory punctures may sometimes be needful for diagnosis.

After complete removal of the contents, it may be desirable to wash out the pleural cavity. For this purpose, towards the roof of the chest a new opening is made, through which weak disinfectants, warmed to blood heat, are introduced, and afterwards withdrawn through the cannula placed in the lower opening. Hoffmann employed

the tube used for carrying off the fluid, for introducing into the thorax solution of chloride of sodium, .5 per cent.; sublimate 1 in 5,000; carbolic acid .5 per cent., or thymol solution warmed to 98° Fahr. What success was attained is not recorded. In man, an incision is sometimes made into the upper part of the thorax (thoracotomy), a portion of a rib removed at a lower point, and the sac freely irrigated. Such operations are far less hopeful in our patients, in which treatment is generally a question, not so much of saving life, as of restoring usefulness. Under these circumstances the operation is burdened with conditions which it is unable to satisfy, and which render it difficult to carry out in private practice. The same is largely true of the surgery of the lung, lately introduced in man, which aims at direct operative treatment of diseased processes in the lungs and in other organs of the chest. As a last resort in the treatment of a valuable patient thoracotomy might, however, be tried.

(2) TAPPING THE PERICARDIUM IN THE DOG.—In the dog, tapping the pericardium becomes necessary in the treatment of exudative pericarditis, which occurs in the acute and chronic forms. Attention is always first attracted by the physical symptoms.

As soon as the pericardium contains a certain quantity of liquid, the heart is thrust upwards and a little forwards, the degree of displacement depending on the amount of exudate. The pericardial sac becomes distended, especially about its base, lifting the pulmonary lobes, and pushing them upwards towards the vertebræ, though to a much less degree than in pleurisy. Thus on palpation of the precordial region the heart's impulse appears weak, or seems lost. On auscultation the normal sounds, clearly detected in health even in very small patients, are dull, distant, and smothered, or completely inaudible. When the heart is but slightly compressed the pulse preserves its character; but as soon as pressure becomes marked the pulse grows small, fugitive, weak, and sometimes almost imperceptible.

Compression of the auricles—the portions of the heart which collapse most readily—impedes the flow of blood, produces cyanosis, venous pulse in the jugulars, and mechanical dyspnœa owing to stasis of blood in the lungs. The symptoms of oppression at first seen are undoubtedly of reflex origin, due to the pain in the inflamed pericardium.

If not treated, acute pericarditis may rapidly lead to death, sometimes in less than a week. It may also (though exceptionally)

terminate in recovery, the exudate becoming reabsorbed, the symptoms gradually diminishing and finally disappearing. In certain cases it assumes the chronic form.

In general, when the veterinary surgeon is called on to examine a dog affected with exudative pericarditis, the disease has already been in existence for some time, occasionally for several weeks; and, provided he makes a complete examination of the patient, and does not forget the heart, a careful consideration of the signs furnished by palpation, percussion, and auscultation should enable him to arrive at a correct diagnosis. Ascites is often the most striking symptom, and puts one on the right path. It is usually easy to differentiate between pericarditis and pleurisy. In pleurisy with moderate exudation, resembling that of pericarditis, the zone of dulness changes with the animal's position. By standing the animal on its hind legs the heart-sounds and vesicular murmur become readily perceptible, while the upper part of the thorax is resonant; in the normal standing position the resonance disappears or becomes dulled.

When, despite treatment, the exudate increases and the symptoms become more marked and alarming, or when even on first examination the general condition appears dangerous, the pericardium can be punctured.

Operation is as follows:—The precordial region is prepared by clipping away the hair, and shaving the skin a little below the centre of the zone of dulness for a distance of two or three square inches. The parts are afterwards washed with alcohol, and with a '1 per cent. solution of sublimate. The aspirator is provided with a rubber tube. The air being exhausted from the cylinder of the aspirator, the instrument is passed to an assistant; the point of the needle is then introduced at the centre of the prepared surface, through the fifth intercostal space three or four fingers' breadth above the lower margin of the thorax. As soon as its end has fairly entered the thoracic wall the tap connected with the aspirator is opened and the needle very gently pushed forward until liquid appears in the glass index of the rubber tube. Operating in this way the needle need only just enter the pericardium, and with a short point, injury of the heart, which is always pushed upwards, need not be feared. Furthermore, by using a small needle, fluid is very slowly withdrawn and danger of syncope prevented. In the absence of an aspirator, puncture may be effected with a fine trocar. The injection of warm 1 per cent. boric acid solution or normal salt solution has been suggested after withdrawal of the fluid contents of the sac, but is difficult

to perform and of doubtful utility. After operation the wound is closed by painting with collodion, and the parts covered with a cotton-wool dressing and a bandage.

During the following days the patient is fed on milk, milk preparations, meat juice, or fragments of raw meat. When appetite returns, more substantial food and tonics may be given.

When pericarditis is complicated with ascites it is not always necessary to tap the abdomen. Once the pericardium is relieved, the peritoneal exudate tends naturally to become absorbed.

SURGICAL DISEASES OF THE ABDOMEN.

THE abdominal walls comprise the skin, yellow elastic tissue, a fibrous aponeurosis, the muscles, a layer of fat, and the peritoneum. The muscles partly overlap and cross one another, and have numerous tendinous expansions. In herbivora the thick abdominal walls, which always appear distended, have to support the bulky digestive viscera, and effectually protect them from external injury, but render examination of them almost impossible. Externally the abdominal walls are clothed with skin, possessing a well-developed subcutis, whilst internally they are lined with peritoneum, which is continuous with that which invests the viscera. The healthy peritoneum is smooth and shining, allowing the viscera to play easily over one another; but when inflamed, exudation occurs, and the surfaces may become adherent. Except as a result of penetrating wounds or severe bruising the abdominal organs are seldom injured from without. Voulton (Stockfleth) found, however, the rumen of an ox ruptured by a blow from a horse's foot. Death rapidly followed from peritonitis. In horses ruptures of the spleen and liver have been observed. The abdominal walls receive their blood from (a) the lumbar arteries which enter between the lumbar muscles, pass across the abdomen, between the outer and inner oblique muscles, and between the latter and the transverse abdominal muscle, and communicate with the other vessels of the abdominal parietes; (b) the anterior abdominal artery which arises from the internal thoracic artery and passes backwards; (c) the posterior abdominal artery which arises from the prepubic, takes a course close below the peritoneum in the middle line, crosses the inner inguinal ring in a forward direction, and anastomoses with the anterior abdominal and lumbar arteries.

I.—BRUISES OF THE ABDOMINAL WALLS.

These occur rather frequently in the domestic animals, and are caused by kicks, thrusts with the horn, by animals rushing together, or by collisions with vehicles. The nature of the injury mainly depends on the character of the injuring body, and the force with which it is applied. Sometimes the walls are ruptured,—a condition described later; whilst the skin, on account of its greater elasticity, remains intact. Sharp objects produce surface wounds, sometimes perforate the abdominal walls, and may even penetrate the internal organs. Bruises of the abdominal parietes from horn-thrusts, &c., are frequent in herbivora, on account of the tension of the abdominal walls; and, as in other regions, are characterised by a subcutaneous solution of continuity in the tissues and vessels. When small blood-vessels and limited tracts of tissue are ruptured, more or less hard,

firm, inflammatory swellings result. When larger vessels are ruptured, swellings (*hæmatomata*) resembling *herniæ* are produced. In large animals extensive extravasations commonly develop in the subcutis, or under the panniculus, but are rarely seen under the slightly elastic, yellow abdominal tunic. The *tunica abdominalis* may likewise be divided, and the rupture mistaken for a hernial opening. But such faulty diagnosis is less serious than when a *hernia* is mistaken for an extravasation or an abscess.

Progress. Simple inflammatory swellings, even when of moderate size and situated on the yellow abdominal tunic, are more easily reabsorbed than large *hæmatomata*. But when the swelling disappears, a portion of the abdominal contents may present itself under the skin. From its fluctuating character this new swelling may be mistaken for an abscess. An abscess, however, is distinguished by its periphery of firm tissue, and sensitive, softening centre. When an abscess forms, it generally perforates outwardly, seldom discharges into the peritoneal cavity and, when opened, usually heals. Inflammatory processes invading the peritoneum cause thickening, and occasionally lead to adhesions limiting the movements of the bowel, the walls of which may give way, as Curdt has noticed in the horse. *Hæmatomata* undergo a course similar to that of inflammatory swellings, but their resorption is less probable. On their breaking or being opened, they discharge offensive fluids and sometimes gas.

In cattle, less frequently in the other domestic animals, chronic abscesses occur in the walls of the abdomen. The cause may escape observation, the injury remaining unrecognised for a considerable period, and like those of strangles, chronic abscesses may have a metastatic origin. In cattle especially, months may elapse before any change is noticed, but then the swelling suddenly and rapidly increases, becomes painful, sometimes contains gas, may produce high fever, and, if not opened, soon breaks.

The appearance of the swelling, as before stated, may vary. It may be firm, hard, and painful: sometimes it is fluctuating. When recent, it is often associated with œdema, especially in deeper lying neighbouring parts, under the belly. As pointed out, it may be mistaken for a *hernia*, and the rule should be observed not to operate before being perfectly convinced of the absence of rupture. The compressibility of the *hernia* is certainly characteristic, but nevertheless mistakes easily occur. In doubtful cases, an exploratory puncture may be made with antiseptic precautions.

Treatment. Newly developed swellings are first treated with cold applications to prevent further extravasation; subsequently

moist warmth is used to assist dispersal. Disinfectants, conjoined with the other applications, will check infection and pus formation. Where this has already occurred, early opening is advisable; indeed, the sooner this is done the sooner will the swelling disappear, but care must be exercised in diagnosis. Owing to the strains thrown on the abdominal muscles in working animals the parts are more liable to tear and produce herniæ, and therefore rest is essential in such cases. Chronic abscesses are best opened as soon as it is clear that no hernia is present, and that incision can be made without fear of severe bleeding.

II.—WOUNDS OF THE ABDOMEN.

WOUNDS of the abdominal parietes may, from a clinical standpoint, be thus divided:—

- (a) Surface wounds; those that do not divide the abdominal walls.
- (b) Penetrating wounds, extending to or dividing the parietal peritoneum.
- (c) Abdominal wounds, with prolapse of internal organs.
- (d) Abdominal wounds, with injury to internal organs.

(a) **Surface wounds**, if not of great extent, and not likely to be followed by further laceration of the abdominal walls, merely require to be kept clean, and are treated on antiseptic principles. A tar plaster is sometimes useful. Bandages are difficult to retain in position, and can generally be dispensed with. Clean straw must be provided for bedding. Where the wound discharges freely, it is dressed with disinfecting fluids. Such wounds generally heal well if freely dressed with iodoform-tannin or glutol. If infection or suppuration extends, counter-openings, drains, or setons are resorted to. Where the walls are extensively lacerated, and further laceration is possible, the wound should be carefully sutured, and supported with a bandage. Strong and deeply-inserted stitches are required, pin sutures may be necessary, and complete rest should be prescribed. Suppuration sometimes occurs between the abdominal muscles. This condition is treated in the same way as sinus-formation in the thoracic region.

(b) **Penetrating wounds** are usually caused by thrusts with the horns, by sharp instruments like stable-forks, lances, bayonets, knives, or scissors, by gun-shots, by injuries from leaping over hedges or fences, or by falling on sharp objects, as harrows, spurs, &c. The bites of dogs may also penetrate the peritoneal cavity. The perforating character of the wound can sometimes be determined

from the appearance of the body producing the wound. The probe should not at once be used, as there is risk of its conveying infective material into the peritoneal cavity. Besides, its value for diagnosis in such cases is small, owing to the layers of muscle being often displaced, and thus occluding the deeper channel of the wound. Where perforation is suspected, the case should be dealt with as if it were proved to exist. Penetration of the peritoneum may shortly be demonstrated by symptoms of peritonitis, marked tension of the abdominal wall, small, wiry, frequent pulse, paleness or dirty red colour of the visible mucous membranes, slight or continuous colic, and, in carnivora, vomiting. Perforation, however, may occur without peritonitis. It may be disclosed by protrusion of abdominal organs, or discharge of the contents of the bowel.

Every penetrating wound of the abdomen must be regarded as dangerous. The abdominal cavity is now, however, frequently opened, with greatly reduced risk, in surgical operations undertaken for the relief of tympanites, abdominal ascites, and the castration of females and cryptorchids. Numerous accidental injuries with perforation often heal, even in circumstances apparently unfavourable to recovery. (For illustrations showing the relative position of the abdominal contents see Figs. 410, 411, and 412, section on "Puncture of the Bowel.")

Prognosis principally depends on whether prolapse of the intestine and peritonitis can be prevented. Unlike men, animals cannot be kept for any considerable period lying on the back, or even quietly in the recumbent position, and there is thus greater danger of prolapse of the bowels. Peritonitis may be prevented by antiseptic treatment of the wound. So long as asepsis is maintained, recovery need not be despaired of. Even where pus formation has occurred, recovery is not impossible, provided the inflammatory disease has not extended to the peritoneum. Retention of septic fluids and their entrance into the abdomen are the chief dangers, and the prognosis largely depends on the progress of the wound. The peritoneum varies in sensitiveness in the various classes of animals. Wounds penetrating it are less serious in carnivora and ruminants, but more so in horses, in which the risks of peritonitis are greater.

Treatment. The chief indications are to maintain asepsis and prevent prolapse of internal organs. The first is attained by careful cleansing and disinfection of the wound and its neighbourhood. If necessary, bleeding must be checked by ligaturing injured vessels, and blood prevented accumulating in the wound, but tampons are only employed in case of need. Foreign bodies, and loose shreds

of tissue, likely to become necrotic, should be removed. The wound is washed out very carefully with disinfectants, one of the best of which is corrosive sublimate. It may then be sutured with sterilised silk; cat-gut is not sufficiently strong. The abdominal muscles and the skin should be brought together separately with deep stitches, so that should washing-out afterwards become necessary the outer stitches alone need be loosened. On account of the great strain which the stitches must support, particularly in herbivora, quilled sutures are employed in closing wounds of the abdominal walls. Where pocketing of considerable quantities of wound discharge is probable, drains must be inserted, and the parts once more rinsed with disinfecting fluid. The several dressings are kept in place by surgical bandages passed around the body; bandages also are sometimes introduced between layers of dressings. In small animals, to prevent displacement from breathing movements, the bandages are wound around both the thorax and abdomen.

Should it subsequently become necessary to cast a large animal in order to insert stitches or adjust dressings, care will be required to prevent prolapse or to protect prolapsed organs. For these purposes it may be necessary to apply a provisional dressing. In many cases anæsthesia is of assistance. After adjusting the dressing, the animal must be kept as quiet as possible. Dogs are often troublesome, and as they try to tear off the dressing, must be continually watched, or receive a full dose of morphine, so that they shall sleep for several hours. The larger animals may, if practicable, be placed in slings.

For several days the food chosen should be digestible, nutritious, and small in amount, and water given only in small quantities. During this time fever may supervene; if not marked and if symptoms of colic are absent, a favourable termination may be expected. The dressing is left undisturbed, unless it become saturated with discharge, or fever or other untoward symptom appear, when it is removed, the wound cleansed, disinfected and the dressing replaced. Where from any cause dressings cannot be employed, the wound, after being cleansed and sutured, is irrigated with antiseptic fluids. Danger of wound infection and peritonitis is greatest during the first three days, but for some time afterwards the same precautions regarding the wound must be observed and care taken to facilitate drainage. A rise in temperature points to peritonitis, or abscess formation, and necessitates fresh examination of the wound, or at least the renewal of the dressing.

(c) **Abdominal Wounds, with Prolapse of Internal Organs.** The prolapse of portions of omentum, bowel, uterus, or other abdominal

organ, constitutes a dangerous complication. The prolapse *per se* is not so dangerous, but there is much difficulty in returning and retaining it in position, preventing soiling and injury and the entrance of infective materials into the peritoneal cavity. Walthard showed by experiments on dogs and cats that the injurious action of the air on the peritoneum depended on the abstraction of moisture, and not on direct chemical irritation, as had previously been supposed. Early reposition is therefore the most important indication.

Omental prolapse is least dangerous, because, in the event of its return being difficult or impossible, a large piece may be removed without bad consequences. This is often done with impunity in castrating horses and other animals. Where the omental protrusion is large and contains important blood-vessels, a portion is withdrawn, a sterilised ligature applied to the healthy part, the portion below cut off, and the remainder thrust back into the peritoneal cavity, or, still better, into the abdominal wound, to which it becomes attached, preventing egress of other organs and, possibly, entrance of infective wound discharge. If the protruded omentum has become soiled or necrosed, its removal is imperative. All experienced practitioners recommend its being further withdrawn and cut off. Möller has repeatedly seen abdominal wounds in dogs and cats, in which the prolapsed omentum was converted by injury into a black greasy mass with an offensive smell, but when this was excised, healing quickly ensued.

Prolapse of the bowel is more dangerous, because the viscus must be returned to the peritoneal cavity. Recoveries nevertheless occur in all animals, provided the protruded portion be carefully cleansed and replaced, and recurrence prevented. It is important to effect reposition before the serous covering has become dry, infected or inflamed. When the serosa is injured its vitality is lowered and the conditions are all in favour of the growth of infective organisms, which are a very serious menace to life. Prolapses of the large intestine are generally least troublesome. In the horse, prolapse of the colon or cæcum, following injury to the under portion of the abdominal walls, is more easily reduced and kept in position than that of the small intestine, because the colic mesentery is shorter than that of the small intestine, the viscus is less sensitive to operative interference, and there is less risk from infective organisms introduced into the abdominal cavity. Drolshagen treated a foal, which had been wounded by a horn thrust; the omentum and bowel were prolapsed, the extruded bowel, which was as large round as a bee-hive, hindered the animal's movements, and compelled it to lie down

frequently. After thorough cleansing the bowel was returned, a portion of the omentum cut off, the wound sutured and a dressing applied. Though it had a few slight attacks of colic, the patient appeared restored to health in three weeks, but four months afterwards it died. Post-mortem showed that the small intestine had passed through a rupture in the mesentery, and become strangulated. Kleinpaul saw a penetrating abdominal wound in the umbilical region of a mare, caused twelve hours previously by injury from the teeth of a harrow. A portion of the small intestine, as large as a man's fist, was prolapsed, œdematous, and swollen. This was replaced, an iodoform dressing applied, and food being withheld for four days, perfect healing resulted. Fourteen days later the mare gave birth to a foal and did well.

In treatment of prolapsed bowel, uterus, or other abdominal viscus, the chief point is to prevent injury and soiling. For this purpose, if large animals have to be cast, a broad cloth soaked in disinfectant fluid is first passed round the body. The wound and its neighbourhood, together with the protruding portion, are then carefully cleansed with a lukewarm disinfecting fluid (carbolic, salicylic, or sublimate solution), and endeavour made to reduce the prolapse, which effected, the wound is once more cleansed, any foreign bodies carefully removed, and the parts stitched up. In some cases it may be necessary to enlarge the wound before reduction can be effected. The after-treatment is similar to that described in penetrating wounds. Should the protruded bowel have become necrotic recovery is rare, and the formation of an artificial anus or resection, which is worth attempting, offers the only chance of saving life (compare "Foreign Bodies in the Bowel"). Small doses of opium check the action of the bowel and diminish danger of peritonitis.

(d) **Abdominal Wounds with Injuries to Contained Organs.** In herbivora the colon is most frequently injured, on account of its great area, its distension with hard food, and its fixed position. The more mobile small intestine being generally filled with fluid frequently evades the object producing the injury. In this way, as experiments have shown, pointed instruments, and even projectiles, may penetrate the abdomen deeply without injuring this intestine. Horses frequently recover from injuries of the colon and cæcum, although their peritoneum is much more sensitive than that of the ox, dog, or pig.

Guilhelm (Stockfleth) saw a horse with a wound produced by a horn thrust $5\frac{1}{4}$ inches in front of the umbilicus, and the under portion of the double colon protruded in a mass as large as a man's head. A wound in the bowel, $3\frac{1}{4}$ inches in length, discharged food material. This was stitched,

the bowel cleansed and replaced, the wound in the abdominal wall sewn, and a dressing applied over all. In spite of great swelling, recovery occurred in twenty-five days.

In this connection, Herbet made experiments in pigs. In castrating a sow, he intentionally thrust his finger through the colon, drew the injured part into the skin wound, and sewed it up with waxed thread. The animal received no food for several days, and recovered. The extent of the recuperative powers is further illustrated by a case reported by Richter. Whilst endeavouring to insert a seton under the belly of an excitable horse, he was unable to separate the skin with his finger and forced to use a probe-pointed bistoury and a seton needle. Immediately the operation was completed, a yellow discharge of food issued from the wound. Examination with the finger showed that the cæcum had been divided to the extent of $\frac{3}{4}$ of an inch. Within a short time 6 to 7 quarts of fluid were discharged, the horse during several days having received only gruel. Richter expected that the animal would die, but the owner determined not to lose its service, and yoked it into a heavy manure waggon. Eight days later Richter found his patient working in a plough, and perfectly well; in twenty days the seton was removed, and the horse remained perfectly healthy. Such favourable conclusions are unfortunately exceptional, but they emphasise the importance of always attempting treatment.

Treatment consists in suturing the injured bowel or uterus with sterilised cat-gut or silk. (For further particulars, compare "Bowel Suture.") The injured organs must then be carefully cleansed and disinfected, the wound and its neighbourhood being next attended to. Sometimes it may be possible to cleanse the peritoneum by washing out the cavity with lukewarm, previously boiled water, or normal saline solution. It might be useful in certain cases to provide drainage by inserting strips of iodoform gauze, or by packing the parts with the same material, as is done in human surgery. The subsequent treatment has already been described. The rumen may be incised without danger, as in rumenotomy and puncture; but, in horses and dogs, injuries of the stomach are serious; more so, in fact, than those of the bowel and uterus. In carnivora they are attended with vomiting, but, although serious, are not always fatal. The treatment of injuries of the stomach is similar to that of wounds of the bowel.

Abdominal wounds, complicated with injury of the kidneys, are distinguished by the passage of bloody urine, and are generally accompanied by paraplegia. In such cases early slaughter is advisable. Injuries to the bladder allow urine to enter the abdominal cavity, and are recognised by anuria, sometimes by urine flowing from the abdominal wound. They almost invariably result in death; but recovery occasionally occurs, especially in carnivora, as shown by Rodloff's case. Wounds of the bowel are sometimes accompanied by the passage of blood-stained fæces. In the dog, vomiting of

blood indicates injury to the stomach. A dog had a penetrating abdominal wound, associated with prolapse of the bowel, which was replaced and the wound sewn up by a layman. In subsequently operating for the rupture, the bladder was cut into. After it had been sewn up and a ligature passed round the hernial sac, both healed. Ponfik's latest researches show that, although most injuries to the liver end in death, yet they are not necessarily fatal.

Stockfleth collected statistics concerning the progress of abdominal wounds, complicated with prolapse of the bowel. In twenty-seven abdominal wounds, prolapse was noticed fifteen times. Of fourteen horses, two mules, two cows, and one dog, two horses, one cow, and one mule died. This result gives, however, no indication of the relative gravity of these abdominal wounds, the successful cases apparently having been selected for publication. The course is usually less favourable. Jewsejenko saw thirty-one abdominal wounds in the horse during the Russo-Turkish war. Those caused by large projectiles were the gravest. The smaller the projectile, the less the danger. Of eight horses with shot-wounds injuring the bowel, five died with peritonitis; three recovered after suturing the wound. Two wounds of the stomach, produced by splinters of granite, led to death. One wound of the stomach from a ball was sutured and healed. Of four wounds of the liver, three were fatal; one case recovered. Of three wounds of the spleen, two ended fatally; one recovered after the projectile had been removed with dressing forceps.

After penetrating wounds of the abdomen, animals, like men, sometimes die rapidly from collapse. It was formerly believed that this peracute progress was owing to shock; but more recently it has become evident that the real cause is profuse bleeding into the abdominal cavity. This must be borne in mind, and in recent injuries the pulse and mucous membranes must be examined before giving a prognosis, or attempting operative interference, which may be blamed for the animal's unlooked-for death.

In order to study the effect of injuries produced by pistol bullets discharged into the abdomen, Parkes experimented on thirty-seven dogs; three died immediately from bleeding from the aorta, or from the renal or splenic arteries; twelve lived for one day, and then died from bleeding, with appearances of shock. The others lived longer; but in almost all the bowel contents obtained entrance into the peritoneal cavity, though they could not be detected in the skin wound. Of the twenty-one which did not immediately perish, two died from peritonitis. Of twenty-one treated by laparotomy, ten died in from three days to three weeks, and nine were cured.

Chaput also produced experimental abdominal wounds and injuries of the abdominal organs in dogs. Of those subjected to immediate treatment the whole recovered; where treatment was expectant only 32 per cent. Chaput therefore recommended performing abdominal section in the middle line, drawing forward and fixing the bowel by passing a director through the mesentery, and suturing the injured spot. Lanzillotti-Buonsanti

collected a large number of clinical records referring to various forms of abdominal injury, from simple perforating wounds to such as involved severe injuries of the contained viscera. Of eighty-three cases in solipeds, sixty-five recovered and eighteen died; five cases in cows all recovered, as did four cases in pigs. Numerous recoveries from similar injuries have more recently been recorded, thanks to antiseptic treatment.

III.—BOWEL FISTULA (ANUS PRETERNATURALIS).

THE term bowel fistula is applied to a direct communication between the lumen of the bowel and the external air through the abdominal wall. A probe introduced into the fistula passes through the abdominal wall directly into the bowel. The opening may occur at different points, but is generally found on the lower surface of the abdomen, in horses often close behind the last rib.

Bowel or gastric fistula—not infrequently produced for physiological objects—may also result from accidental injuries penetrating the abdominal coats, and Curdt related cases of the kind both in the horse and the ox. Howard produced fistula of the colon in a sucking pig, which was suffering from atresia ani, in order to save the animal. If, in penetrating abdominal wounds, the intestine is laid open, its edges may unite to the abdominal wound and external skin, and produce a bowel fistula. Arndt, Lindenberg, Dammann, and others have described such cases in horses and oxen. The injury, however, sometimes originates in the gastric or intestinal mucous membrane. The serosa becomes inflamed and firmly adherent to the wall of the abdomen, and if now abscess formation occurs, the abdominal walls may be perforated and a bowel fistula produced. Körber saw a horse suffer in this way after an attack of colic. Perforation had occurred close to the middle line of the abdomen behind the umbilicus. Urban reported a similar case in a foal, in which an umbilical hernia had been opened, producing bowel fistula. Bayer noted a like accident after dressing an umbilical hernia with nitric acid. Fürstenberg describes a fistula of the abomasum in a cow. Seven to ten minutes after receiving water, a stream of fluid mixed with food was projected several feet beyond the wound. Flourens produced fistula of the rumen artificially for the purpose of studying rumination in oxen and sheep, and Haubner saw gastric fistula in sheep result from giving arsenic insufficiently powdered. Foreign bodies swallowed by cattle often produce gastric fistulæ, and perforate the wall of the abdomen, or that of the thorax close behind the elbow, but these generally heal. Strecke found one half of a pair of scissors in the abscess. Dammann describes a case complicated with hernia

in a nine-year-old mare. The fistula had resulted from an external injury.

Symptoms and course. Animals, with intestinal fistula, may survive a long time, and, if liberally fed, may even remain in good condition, though the constant discharge constitutes a blemish. Urban kept a foal under observation for two years. In spite of generous feeding it remained thin, and on that account was finally killed. In another case recovery took place.

Treatment should be directed to preventing discharge of bowel contents, which is the chief obstacle to healing. Körber succeeded by passing a red-hot wire into the fistula, after which cicatrisation occurred in twelve days. Lindenberg recommends a purse-string suture, inserted as deeply as possible so as to bring together the inner end of the fistula, *i.e.*, the opening into the intestinal wall. It is not sufficient to close the external opening by bringing the skin together, as new abscesses continually form. Dammann used sutures in one case, but attacks of colic occurred and caused the ligatures to tear out, and as the animal was no better after five months' treatment, it was killed as incurable. Where the opening is small, dressing with irritants, or the use of the actual cautery, may cause swelling of the edges and union; but should this fail, a strong thread may be passed through the muscular walls of the abdomen. Dammann cured the second case in two months by using liquor Villati, applied on a mass of tow and kept in position with a bandage. Should the injured portion of bowel have become adherent to the abdominal wall, a section may be excised and the divided ends united by sutures, or in the case of small animals by using Murphy's button or a tube of decalcified bone.

IV.—PARACENTESIS ABDOMINIS (PUNCTURE OF THE ABDOMEN).

SEROUS fluid collects in the peritoneal sac in consequence of chronic inflammation of the peritoneum, or more frequently of disease of the kidneys, liver, or disturbance of cardiac circulation, and may require to be removed by tapping. The peritoneum certainly possesses the power of rapidly taking up large quantities of fluid and returning them to the circulation, as clinical and experimental observations have shown; and these facts accord with our conception of the peritoneal cavity as a great lymph-sac. When, therefore, fluids remain for long unabsorbed, some special cause must be at work, and as that cause is not removed by draining away the fluid, the latter usually returns after a short time. For this reason the

operation has, at the most, only a symptomatic importance. It may, by relieving pressure on the diaphragm, mitigate difficulty in breathing, but it seldom produces lasting improvement.

Diagnosis of ascites is seldom difficult where so much fluid is present as to call for puncture. The disease is commonest in dogs, whose abdominal walls allow the viscera to be readily examined. Such an examination may give valuable information as to the cause of dropsy. One often finds chronic changes (tumours, &c.) in the liver, which render exceedingly improbable any lasting benefit from operation. The same is true where the dog suffers from heart disease. In such cases the abdomen often shows unmistakable distension, which is sometimes attended with dyspnœa. When the animal is standing, the wave-like movement of the fluid may be felt by placing the left hand on one side of the abdomen and lightly tapping the other side with the right. This phenomenon, termed "*Succussio Hippocratis*," is a reliable symptom of dropsy.

Tapping the peritoneal sac—a very simple operation—is effected with a trocar of the same size as is employed in puncturing the chest. There being no danger here, as in puncture of the intestine, of infecting the peritoneal cavity from the bowel, and it being easy to disinfect the skin, the operation, when carefully carried out, is quite simple and not likely to give rise to peritonitis. Indeed, in former times, when the principles of strict asepsis were not understood, the operation was usually performed quite successfully without antiseptics.

The puncture was formerly made through the rectum or vagina, but these points have been abandoned because of the risk of infection, and the operation is now performed either in the neighbourhood of the umbilicus close to the linea alba, or on one side of the abdominal wall, the former being usually selected in small animals. In large animals, which are operated on in the standing position, the side of the abdominal wall is more convenient. In cattle the right side is chosen, so as not to injure the rumen, which lies on the left; in horses the left side, because the cæcum is on the right. The bowels, being partly filled with gas, float on the fluid in the lower portion of the abdominal cavity, which is consequently the point selected for puncture. In large animals the operation is performed as follows: After shaving and disinfecting the point of operation, an incision is made through the skin with a pointed bistoury or lancet to assist the passage of the trocar. Puncture is then effected in the same way as puncture of the thorax. The trocar is carefully disinfected and held with the handle in the operator's palm, whilst the forefinger, lying on the cannula, limits the distance to which the

instrument may penetrate. In larger animals, $1\frac{1}{4}$ to 2 inches may be allowed; in smaller ones, $\frac{3}{4}$ to $1\frac{1}{4}$ inches. As soon as the trocar has entered, the stilette is withdrawn, and the fluid allowed to discharge. Sometimes a check occurs, and the cannula requires to be moved in various directions, or cleared of clots by passing the stilette or a probe. As soon as the fluid ceases to flow, the trocar may be removed, and the wound treated as in operating on the chest.

In operating on the dog, the animal may be laid on the side, or held in the standing position. Either side may be punctured provided the opening is made close to the middle line. The under surface of the abdomen should be disinfected and the operation performed between the umbilicus and the anterior pubic border, as this position offers less danger of injuring the stomach or liver, which is often increased in size from chronic disease. Not infrequently it is necessary to repeat the operation after an interval of a week or ten days.

An abdominal bandage, with a small "window," may be applied before operation, so that by tightening it as the fluid escapes intra-abdominal pressure may be sustained and syncope prevented. After operation, bandages prevent further transudation, though unfortunately in dogs they can seldom be kept in place. To prevent recurrence of ascites, intra-peritoneal injections of alcohol or solution of iodine, and the administration, per os, of diuretics, like potassium citrate, juniper, digitalis, have been recommended, but this treatment has given little satisfaction. Recently, in man, attempts have been made to modify the portal circulation and thus prevent recurrence of dropsy, by producing permanent adhesion between the omentum and the abdominal wall.

V.—HERNIA.

HERNIA or rupture is a condition in which portions of the abdominal contents have passed through the abdominal walls, and lie under the skin. Should they pass through the skin, the condition is termed prolapse. The passage of abdominal organs through the diaphragm into the thorax is also described as hernia (diaphragmatic hernia), and in oxen strangulation of the bowel by the spermatic cord is termed pelvic hernia, although in the true sense of the word they belong less to the herniæ than to the incarcerations.

The cause of hernia is sometimes a congenital defect, like too wide an inguinal ring or an open umbilicus. Such herniæ are, therefore, either congenital, or develop soon after birth. Increase of intra-abdominal pressure, frequent coughing, dyspnœa, pressure

on the abdomen, or development of gas in the bowel (tympanites), all assist their formation, while rupture of the abdominal wall directly produces them. Such rupture may be produced during parturition, or by excessive exertion, severe pressure on the abdomen, or the violent impact of blunt bodies. In men, external influences, such as the pull of lipomatous new growths on the abdominal walls, may induce local pocketing and prepare the way for ruptures; but such cases are seldom seen in animals.

The essential constituents of a hernia are :—

(1) The opening in the abdominal wall through which the viscus has protruded may be a normal opening like the umbilicus, or one abnormally dilated, as the inguinal canal sometimes is, or a rupture in the abdominal coats, without solution of continuity in the skin.

The rim of this orifice is termed the hernial ring. Its form and size vary greatly. Sometimes it will only admit the little finger, but in large animals it may be the diameter of a man's fist. Sometimes it is round, sometimes oval or slit-like. In umbilical and inguinal herniæ it is lined with peritoneum. In a fresh ventral hernia the edges of the ring are formed by the ruptured abdominal coats.

(2) The hernial swelling, which may vary from the size of a hazel nut to that of a man's head or more, consists of the portion of protruded viscus ("hernial contents"), and its coverings, the hernial "sac." The latter is divided into neck and base. The hernial sac consists of skin and subcutis, the latter usually thickened, sometimes of layers of muscle and abdominal fasciæ. The sacs of umbilical, inguinal, and femoral herniæ, and those whose openings consist of abnormally dilated physiological apertures, are lined with peritoneum. In those produced by tearing of the abdominal walls, the peritoneum is usually divided; the internal organs may then lie under the subcutis, and only be covered by the latter and the skin.

The contents as a rule consist of either a loop of intestine (enterocele) or of omentum (epiplocele). Sometimes enterocele and epiplocele co-exist forming entero-epiplocele. Only occasionally are other internal organs like the stomach (gastrocele), uterus, bladder, or liver found in the hernial sac. Sometimes the sac also contains a serous fluid (hernial fluid).

In **reducible** ruptures the contents lie free in the sac, and may be returned to the peritoneal cavity (reposition, taxis); but sometimes the hernial contents and sac become adherent to one another, and complete reposition can only be effected after division of the adhesion. This constitutes **irreducible** hernia. The irreducible

character may also be due to strangulation or other causes, like excessive distension of the protruded portion of intestine by gas or hard masses of fæces.

Diagnosis. A hernia is seldom difficult to recognise, provided it be reducible. In such case it has the following characteristics :—

(a) It is free from inflammatory symptoms (especially pain), is soft, elastic, and compressible, that is, it may be diminished by pressure.

(b) It varies in size from time to time ; coughing or severe exertion increase abdominal pressure and render it larger ; but it decreases when intra-abdominal pressure again falls.

(c) It is reducible, that is, the swelling may completely disappear on pressure, or on placing the animal in a suitable position, but it returns on removal of pressure or alteration of position. Irreducibility may be suspected when the hernial swelling undergoes little or no alteration in size from day to day.

Diagnosis only becomes absolute when the hernial opening is discovered. It can generally be felt by thrusting a finger into the depth of the sac, especially after reducing the hernia. Examination *per anum* is sometimes useful in horses and oxen ; the hernial ring and the contained bowel may be felt ; by traction on the bowel the hernia can sometimes be reduced. Exploratory puncture may also be resorted to in otherwise doubtful cases. Some care is required to differentiate hernia from abscess or hæmatoma, an error which might have grave consequences, as pointed out in referring to bruises of the abdomen.

Prognosis. Reducible hernia is not a fatal condition, but immediately strangulation occurs it becomes exceedingly dangerous. Prognosis chiefly depends on the probability of strangulation, a factor which will be considered under the various herniæ. The smaller the hernial aperture compared with the size of the sac, the greater the danger of strangulation. Small intestine becomes more easily strangulated than colon or omentum. The size of the aperture, and the use to which the animal is put, must be considered, whilst it should be remembered that strangulation occurs more easily in working-horses, and that large herniæ may interfere with usefulness.

Many herniæ, and especially umbilical and inguinal herniæ in young animals, disappear without treatment, and others may last the animal's whole life without interfering with its use.

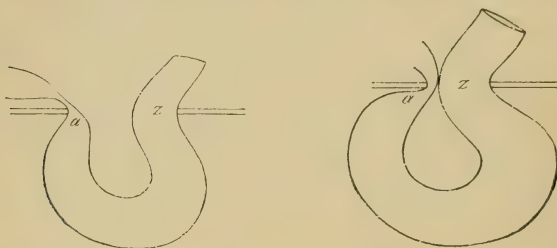
Irreducible herniæ are more dangerous than reducible, recent than old, and intestinal than omental, because in each case the former are more likely to become incarcerated than the latter.

Strangulation or incarceration is the condition in which the hernial ring compresses the contents and interferes with normal circulation of blood and passage of ingesta through the intestinal loop. In consequence of this compression the return of blood through the veins is first checked. In them blood-pressure is lower, and the walls weaker, and therefore circulation is more easily interfered with than in the arteries, whose strong walls and high blood-pressure oppose considerable resistance to compression. Blood continues, therefore, to enter by the arteries even after the inception of strangulation, and soon produces a severe venous congestion, usually associated with more or less extensive rupture of small vessels and hæmorrhage. Infective inflammation of the intestinal wall follows, blood-stained serum is exuded, the hernial fluid increases, and in consequence of mixture with blood becomes red in colour. The hernial contents, especially the serosa of the intestine, are dark red or black, and this coloration is distinctly and usually sharply bounded by the ring-like circle of compression, which is usually grey and anæmic. Both this anæmia and the venous congestion impair nutrition in the strangulated parts, which if not relieved undergo necrosis. Stasis adds to the disturbance thus produced, because the imprisoned intestinal contents putrefy, irritate the mucous membrane, and co-operate with defective circulation in inducing necrosis of the mucous membrane.

Necrosis first shows itself at two points, viz., in the deepest portion of the hernial contents, where circulation suffers most, and at the line of strangulation. It is well to remember, from the clinical standpoint, that dark colour is not always a proof of necrosis. The latter is usually typified by the presence of grey patches on the surface of the peritoneum, or of ulcerative changes in the hernial contents. Necrosis is suggested by the presence of offensive fluid or gas in the hernial sac. The anterior portion of the bowel—that is, the part nearest the stomach—appears greatly distended with food, whilst the posterior portion may be empty and narrower than normal.

Causes. Strangulation was formerly believed to be produced by spasmodic contraction of the hernial ring; but, apart from the fact that in most ruptures such contraction seems scarcely possible, it is not to be imagined that active contraction could continue so long. Such views are no longer entertained, and the cause of strangulation is to be sought rather in the character of the hernial contents. Inflammatory swelling near the neck of the hernia may in exceptional cases cause incarceration, but is exceedingly rare. The primary factor in incarceration is usually increase in the hernial

contents; conversely this increase may be a result of incarceration. Let us imagine a case: A horse affected with hernia suffers from tympanites; the increased intra-abdominal pressure thrusts a large portion of bowel and omentum from the abdominal cavity into the hernial sac; on account of the increase of the hernial contents the ring becomes too narrow; it presses on the enlarged contents and interferes with circulation in the parts which it surrounds, and incarceration results (Figs. 389 and 390). Or let us fancy that in the posterior portion of the intestinal tube—that is, in the portion through which the intestinal contents are returned from the hernial sac into the abdominal cavity—some check occurs, causing fæcal stasis. Necessarily the hernial sac must become more or less filled with intestinal contents, which enter through the anterior portion



FIGS. 389, 390.—Showing mechanism of incarceration of intestine—
(a) Efferent, (z) Afferent, portion of intestinal loop.

of the intestinal tube, but cannot escape. Distension may finally become so great that the hernial ring acts as a ligature, and incarceration results after this fashion. The forward movements of intestinal contents may be variously impeded. Thus the posterior portion of intestine not infrequently becomes twisted either in the hernial sac or in the peritoneal cavity, particularly at its point of exit from the ring, and the twist, which acts like a kink in a rubber tube, may produce fæcal stasis in the hernial sac and incarceration. In the same way gradual distension of the anterior portion of the loop of intestine lying in the hernial sac may displace or compress the posterior portion, and bring about fæcal stasis and incarceration. According to Rose, folds of mucous membrane in the posterior portion of the loop diminish the passage under certain circumstances, and produce similar results. In man statistics have been accumulated on the mechanism of strangulation, and attempts have also been made to solve the question of its origin by experiments on animals.

But both in men and in animals the first causes may be so varied that they cannot usually be explained, and therefore the question is here of no great importance.

The views on omental strangulation are just as varied, though all coincide in declaring that omental herniæ are less often strangulated than intestinal. Some, like Rose, altogether doubt its occurrence, and have supported their opinions by experimentally ligaturing the omentum. Others allow its occurrence, and insist that its symptoms are similar to those of strangulation of the intestine, but less pronounced, because the circulation alone is interfered with.

Diagnosis is seldom difficult. As a rule, symptoms of colic appear, and in carnivora vomiting. The pain is regular and lasting. In cases of colic in ruptured horses care should invariably be taken to first examine the hernial sac. If strangulated, the hernia will be found to have increased in size, become hard, painful, and tenser than formerly. Symptoms of peritonitis set in, and the animal soon dies if reduction is not effected. The occurrence of albuminuria in strangulated hernia is certainly interesting from a scientific standpoint, but not clinically.

Prognosis. Strangulated herniæ usually kill in a short time, not infrequently in twenty-four hours, and as reposition is often difficult or comes too late—that is, when necrosis has already set in—the condition must always be viewed as dangerous. Spontaneous reduction is exceedingly rare, partly on account of the increasing accumulation of ingesta in the hernial loop, and partly because the incarcerated section of bowel soon becomes paralysed in consequence of defective circulation, and is then unable to discharge its contents, even when the causes of strangulation have been removed.

Treatment of non-strangulated herniæ. In many cases, particularly in slight herniæ in young animals, no treatment is required, because spontaneous recovery is usual, strangulation rare. Peculiarities of treatment will be separately described in connection with each of the various herniæ. One differentiates a palliative cure, and a radical cure. The first consists in bringing about a gradual diminution in the hernial sac; the radical cure in closing the hernial opening.

The palliative cure depends on suitable dietetic precautions, supplying concentrated and easily digested food, avoiding hard work, and in larger animals on the preservation of a suitable position, that is to say, a position in which, whilst the animal is in the stall, the viscera will be as far as possible removed from the position of

the hernia. These measures may be supplemented by the following :—

(1) Hernial truss. Although much used in men, trusses cannot be employed to the same extent in domestic animals. Trusses for inguinal herniæ in animals, other than foals, are impracticable, and it is only in exceptional cases that they can be continuously worn in other abdominal herniæ, though the male hippopotamus in the Berlin Zoological Garden wore such a truss for a considerable time. These appliances will be described in speaking of inguinal herniæ.

(2) Diminution in the hernial sac and return of the hernial contents into the abdomen, by inflammatory and cicatricial processes in the skin of the sac produced by sulphuric, nitric, or chromic acid, by the application of the actual cautery, or by subcutaneous injections of common salt, alcohol, &c. The artificial inflammation is accompanied by swelling in the skin and subcutis, and the contents of the hernia are said to be gradually forced into the peritoneal cavity. Cicatricial contraction of the cutis follows, and thus diminishes the size of the hernial sac, and even of the hernial aperture. The cautery, lately recommended in man, has the same effect. Radical treatment consists in removal of the sac and closure of the hernial aperture by causing the hernial ring or the neck of the hernial sac to unite, or by other methods. This procedure presents greater difficulties in animals than in men, because it is neither so easy to attain asepsis, nor to keep the animal in the necessary dorsal position after operation.

The following methods of radical cure are employed :—

(1) Ligation of the hernial sac. This can only be resorted to where the sac possesses a narrow neck. To prevent displacement of the ligature, it has been recommended to pass needles transversely through the neck of the sac, and to apply the ligature over them. It need scarcely be said that the hernia must first be reduced.

(2) In hernia with a broad base interrupted ligatures may be employed. After returning the hernia, strong threads of sterilised silk are passed through the neck of the sac close to the hernial opening. The procedure consists thereafter in multiple ligation; the skin of the hernial sac can then be cut through and separated from underlying tissues, the other coats of the hernia similarly treated, and the skin brought together over them. This method is frequently employed, and usually allows of healing by first intention, which greatly tends to ensure success.

The hernial sac may also be opened, and, after multiple ligation of its neck, removed, following which the skin should be closed with

sutures. Healing is often completed without pus formation. But in large animals, and especially in herbivora, suturing the hernial ring often presents insurmountable obstacles, because the abdominal walls are too firm and resistant to allow of approximation and union. Where the aperture is slit-like, further trouble is often caused by the hernial contents having become adherent to the abdominal walls, and dissection is both difficult and very dangerous. After freeing the bowel, or cutting off the omentum, or, if necessary, ligaturing it, the hernial contents are returned to the abdomen and the ring sutured. To assist union of the cicatrised edges of the hernial ring, they can be pared with the knife or scissors, or numerous superficial incisions made. In inserting sutures, the left hand holds back the viscera to protect them from the needle. The edges are brought together with strong, carefully sterilised silk, the hernial ring being as far as possible closed. Where tension is great, quilled sutures are useful. The skin is afterwards brought together with strong material, a deep hold being taken.

It is scarcely necessary to add that the strictest antisepsis must be observed, without which there is always danger of peritonitis, and closure occurs far less rapidly and certainly. Finally, a radical cure may be effected by applying a clam to the neck of the hernial sac, a method generally employed in umbilical hernia, and described under that head.

Treatment of strangulated herniæ. It has already been stated that incarceration is always dangerous, and that treatment should at once be resorted to. The latter consists primarily in attempting reduction. For this purpose the animal should be placed so that the hernia is as elevated as possible, as the contents then tend to return to the abdominal cavity by their own weight. The restlessness of horses, and the tendency they have when cast to contract the abdominal muscles, often cause difficulty in reposition. To avoid this, anæsthesia should be produced, without which reposition cannot be satisfactorily effected in large animals. In horses, chloroform, in cattle, chloral or chloroform, and in dogs, morphine is usually employed. In oxen it is often preferable to slaughter the animal, because the use of chloroform may make the flesh unfit for food.

It should be remembered that the obstruction always lies near the hernial ring, and therefore that any attempts at reduction must be directed to this point, pressure at the base of the hernial sac being mere waste of time. In extensive hernia, the sac is grasped with both hands, the points of the fingers lying near the hernial opening.

Attempts are then made to diminish or return the contents lying immediately over it, and by gradually applied pressure, to get rid of the obstruction. Cold applications often have a favourable influence, and greatly assist in effecting taxis. In Paris, where stallions are extensively employed and strangulated herniæ correspondingly common, the attendants have instructions in such cases to keep a jet of cold water turned on the parts until the arrival of the veterinary surgeon. It is said that when so treated the majority of cases can be reduced by taxis.

Where the bowel is thought to be twisted on the abdominal side of the ring, the sac should be moved sideways, so as to lift the twist and set free the bowel contents. This must be done slowly but continuously and in different directions, because it is impossible to tell exactly where the obstacle lies. A gurgling sound may then sometimes be heard, indicating the evacuation of the imprisoned intestine. Diminution of the swelling under the fingers is a still more favourable sign. Reduction may sometimes be effected by a hand in the rectum exercising *very cautious* traction on the incarcerated portion of bowel. The greatest care is, however, required.

Failing reduction by this method within half an hour, an incision (herniotomy) must be made, or, under certain circumstances, may be resorted to at first. Should it be clear that the displaced intestine is already semi-necrotic or is ruptured in the hernial sac, one dare not proceed to reposition on account of setting up peritonitis. The longer, therefore, strangulation has continued, the more careful should the operator be in attempting reduction. Inflammation of the hernial sac and emphysema of the skin clearly point to rupture of the bowel having taken place, a condition which is usually fatal in animals.

Incision (herniotomy) is resorted to, to remove strangulation, and may be carried out in various ways. In human surgery a distinction is made between hernial incision without opening the peritoneal cavity, and a similar operation with division of the peritoneum. The first or **external herniotomy** offers great difficulties, but was formerly more often practised than at present; nowadays the second method, or **internal herniotomy**, is more frequently resorted to as the use of antiseptics has greatly diminished danger from peritonitis. The same is true in animals. The procedure in performing the external operation is as follows:—The seat of operation is carefully disinfected, the animal anaesthetised and placed in a suitable position, and an incision, which must extend the entire

length of the sac, is made through the skin covering the hernial swelling. After dividing the subcutaneous coverings to a similar extent, an attempt is made to reach the hernial ring. Large vessels are ligatured to keep the field of operation clear, firm portions of connective tissue divided with the scissors or knife. By introducing the finger into the depths, one can discover the narrowest, that is, the strangulated, spot, which is then widened with a herniotome or tenotome outside the peritoneum. This effected, reduction by taxis becomes easy, and the wound is at once carefully cleansed and sutured after the manner described under non-strangulated hernia.

Internal herniotomy requires similar preparations. The incision is made through the skin in the same way, and the hernial coats lying beneath divided with a knife as far as the peritoneum. A little fold of the latter, at the base of the hernial sac, is then raised with forceps, and cut through close below the forceps with a knife held horizontally, producing a small opening. Employing a director and blunt-pointed scissors this opening is enlarged, the index finger passed into the hernial sac, and the peritoneum incised as far as the neck of the sac, the finger meanwhile pressing back the hernial contents and protecting them from injury. The finger is now passed into the hernial opening, the herniotome introduced alongside it, and the ring or neck of the hernial sac divided at the point of strangulation. A slight incision suffices to enable the contents of the sac to be returned to the abdomen, unless the hernia is adherent.

In umbilical and abdominal herniæ, hernia knives are replaced by blunt-pointed tenotomes of various forms. A special herniotome is only necessary in inguinal hernia in the horse.

Internal herniotomy has the advantage over the external operation that one can determine the condition of the strangulated bowel, and should the latter prove to be necrotic, can either proceed to further treatment or resection of the necrotic portion. Reposition, under these circumstances, would destroy any chance of recovery. It should, however, be repeated that dark coloration does not always indicate necrosis.

It is necessary in such cases promptly to decide whether to attempt resection of the necrotic bowel, a proceeding which, though certainly offering greater chance of success in carnivora than in herbivora, especially in horses, is even in them eminently fatal. Incarcerated portions of omentum, which, however, are seldom met with, are first ligatured with aseptic material and then cut off, and the wound treated as before described. It is of the highest importance to secure

asepsis and prevent prolapse of the intestine. Perfect cleanliness ensures the first, and carefully-inserted quilled sutures lead to proper union of the edges of the wound.

Should resection of a necrotic portion of intestine be deemed advisable, it is very important to avoid infecting the peritoneal cavity with intestinal contents, and carefully to provide for union of the ends of the resected bowel. The intestine is drawn forward as far as necessary, and protected by layers of cloth dipped in warm disinfectant solution.

After excising the necrotic portion with scissors, the ends of the intestine must be rinsed with carbolic or normal saline solution, and their contents, as far as possible, removed without soiling the wound. An assistant using both hands gently compresses the gut between his fingers, and the ends are then so brought together that the two serous surfaces are in apposition. To effect this, the free edges of the posterior portion are turned inwards, the anterior end pushed into this, and the two sewn together with closely applied stitches. After once more carefully cleansing the intestine, it is returned, the wound disinfected, and stitches inserted as above described. Experiments made many years ago with the simplest apparatus in cases of invagination show that under some circumstances, especially in oxen, resection of the intestine may prove successful (compare with the section on "Suturing the Intestine").

VI.—UMBILICAL HERNIA (OMPHALOCLE, EXOMPHALOS).

By union of the visceral plates in the linea alba, the abdomen closes during uterine life as far as the annulus umbilicalis, which remains open for the umbilical cord, and after birth ceases to exist on account of obliteration of its vessels. In new-born animals the umbilical ring not infrequently appears abnormally large, so that the umbilical cord does not completely fill it, in consequence of which the skin and peritoneum either immediately or in the first few weeks after birth, yield to the pressure of the abdominal contents, and allow the latter to pass through under the skin. This condition, which occurs in different classes of animals, though most frequently in horses, oxen, and dogs, has been termed umbilical hernia, and is divided into two forms,—viz., congenital, which is apparent at birth, and acquired, which appears during the first few weeks thereafter or subsequently.

As a rule, a portion of the colon, cæcum, small intestine, or sometimes omentum, is found in the hernial sac, which is composed of

skin and peritoneum, and which varies in size from a hazel-nut to that of a man's head.

Causes. This condition is always due to abnormal size of the umbilical ring. The larger this is the more easily does hernia occur. This explains the hereditary character of umbilical herniæ, as observed by Viborg and Eléonet in horses, and Benkert in dogs (Stockfleth). In some congenital cases, the herniated viscus has never been in the abdominal cavity, because it has not been surrounded by the visceral plates. After birth, umbilical hernia results either from over-stretching of the skin covering the umbilicus, *e.g.*, from violent tearing away of the umbilical cord; or it may be caused by any circumstance producing increase of intra-abdominal pressure, such as tympanites, excessive action of the abdominal muscles during constipation (*e.g.*, atresia ani), severe exertion and continuous coughing. It seldom develops in old animals.

Symptoms. Umbilical hernia is recognised by the presence of a swelling of the size above mentioned, which lies below the umbilicus, is elastic, soft, sharply defined, and free from inflammatory symptoms. It usually takes the form of a larger or smaller hemisphere, and seldom possesses a neck. By thrusting one or two fingers upwards into the swelling, the umbilical ring can be discovered in the depth. Sometimes it scarcely admits a finger, sometimes the entire hand can be thrust into it. By laying the animal on its back, or pressing on the swelling with the open hand, it disappears.

No mistake can well occur, except in young animals with inflammatory disease of the umbilicus; but caution is required in using the knife, because such herniæ have often been incised with the idea that they were abscesses. Where the umbilical ring cannot be felt, or its complete closure ascertained, every fluctuating swelling at this point must arouse suspicion of umbilical hernia. In dogs, and occasionally in oxen, a swelling the size of a walnut is seen in the umbilical region. It is not a hernia, but is due to thickening of the subcutis, or to remnants of the umbilical cord, which has ruptured or been divided at too low a point. The swelling is not affected by pressure, and the umbilical ring is closed. In oxen this thickened tissue sometimes becomes inflamed and suppurates.

Prognosis. This depends, first, on the size of the umbilical opening, and then on the size of the sac and the age of the animal. Spontaneous recovery is common, and is favoured by small size of the rupture, absence of adhesions and youth of the animal. In herbivora a small umbilical hernia generally disappears as soon as the animal begins to receive solid food, which produces distension

of the colon, and as growth advances the abdomen enlarges, with increasing tension of the mesentery, parietal peritoneum, and skin, by which the hernia is gradually withdrawn into the peritoneal cavity. Spontaneous reduction in foals and calves may thus occur during the first year of life, though seldom after this age. Incarceration is only exceptionally seen in animals, and then only in such as suffer from tympanites, in greedy feeders, in those inclined to digestive disturbances associated with flatulance, or after injury to the hernial sac, or the formation of adhesions which prevent spontaneous recovery.

Treatment. The most varied applications, most of them of little value, have been recommended in umbilical herniæ. Amongst these are local astringents and the subcutaneous injection of solution of common salt. Such treatment is only followed by recovery where the latter is almost a foregone conclusion, as in small ruptures in young animals and particularly in herbivora. Amongst the palliatives most resorted to are—

(1) Trusses, which are, however, only of real use in cattle and horses, and even then to a limited extent. A tampon of tow, smeared with Venice turpentine to retain it in position, is placed on the hernia and fastened by a girth passed round the body. Kölling in this way cured umbilical herniæ in foals in six weeks. Marbot states having cured ten cases of the kind in thirty-two days by means of bandages. As a substitute for the bandage, a pitch plaster may be applied, or the sac painted with collodion after reducing the hernia, but neither method is reliable, especially on the very elastic skin of dogs, and plasters seldom remain a sufficient time in position to have any permanent good effect.

(2) Caustic and blistering substances, like sulphuric or nitric acid or cantharides ointment, applied to the hernial sac, have been recommended in the larger animals (horse and ox). In France nitric acid was first recommended in 1848 by Dagot, and about the same time it was used in Germany in common with sulphuric acid. The latter is generally diluted with 3 to 5 parts of water or spirit, and rubbed into the hernial sac daily for five to eight days. Concentrated sulphuric or nitric acid is applied with a glass rod in the form of lines. The lines must be at least $\frac{3}{8}$ to $\frac{1}{2}$ of an inch apart, and the acid can seldom be used more than twice. Others apply the concentrated sulphuric acid with a brush to the entire surface of the sac twice, beginning at the periphery, and taking care that the lowest portion of the sac does not receive too much. Particular care is required in applying concentrated nitric acid, and it should never be left to

the owner, but be used by the practitioner himself. The irritant effect is sometimes too great, and, owing to excessive swelling and tension, the skin tears through or becomes necrotic before union has taken place at the neck of the hernial sac. Prolapse of the bowel then occurs, as noted by Weber in foals and Roche-Lubin in dogs. The thinner the sac and the skin covering it, the greater the care required in applying concentrated acids. Duriaux and Cagny recommended sinapisms instead of acids, stating that mustard produces the same effect as acids, but is less dangerous. Acids are useful for this purpose, because they do not soften the structure of the skin like alkalies, but give a firm scab. Nitric acid produces a stronger effect than sulphuric, and is, therefore, more painful and dangerous, while chromic acid and bichromate of potash (1 to 3) often affect deep-seated structures too much. The swelling which appears is the best guide, and immediately it seems sufficient, further application should be avoided.

The actual cautery has been recommended with the same object, and is applied in the form of lines. In France and Belgium bandages and blistering ointments have been simultaneously used, but this "mixed" method is not commendable.

For the horse Degive recommends a bandage which carries a plate of tinned iron, 14 inches long and 4 broad, formed to respond to the lower surface of the belly, upon which it is fastened by two rollers. The plate has a rounded prominence about 2 inches high on the side next the abdomen, which fits into the hernial ring and keeps back the contents. This truss is worn for four to eight days, when swelling of the ring occurs, and it may be removed to see whether the hernia returns. Should this happen, the parts can either be dressed all over with diluted nitric acid or be fired, after which a second bandage is applied, whose girth carries a similar plate 14 inches long and 9 inches broad, covered with a tarred linen compress. Three days later the parts may be blistered with cantharides oil to assist the separation of the eschar, which is said to occur eight days afterwards. The girth is then loosened a little and reapplied, after smearing the rupture with tar. Martin states having cured umbilical herniæ in this way within twenty days.

Without doubt the pressure of the bandage on the inflamed hernial sac assists its contraction and the return of the contents, but necrosis of the sac is apt to occur, and the truss must, therefore, be frequently examined.

Imminger recommends injecting subcutaneously 1 to 1½ ounces of a 15 per cent. salt solution about an inch in front of, and also

behind the rupture. One injection is said to be sufficient to cure small herniæ in four to six weeks. Thickening remains for some time, but this is thought to close the ring. Lucet injects from 2 to 7 ounces of a similar solution all round the ring.

These methods assist return of hernial contents to the abdominal cavity by the swelling they cause, an action which is continued by the subsequent cicatricial contraction of the skin. Acids are preferable to blistering ointments, as, *e.g.*, cantharides; and Hupe states that inguinal herniæ in foals can be cured with certainty during the first six months of life by smearing with sulphuric acid.

This treatment is only suitable to small herniæ in young animals; in larger herniæ it is of no value, and Degive restricts its use to cases where not more than two fingers can be introduced into the hernial opening, and where the sac is not larger than a hen's egg. Where irritants have failed, the hernial contents often become adherent to the sac, and may later cause difficulty in operative treatment.

(3) The following methods of radical treatment have been employed:—

(a) Simple or multiple ligation of the sac. This is best performed in spring or autumn and at a time when the animal is otherwise in good health. The limits of the sac should be marked before casting. In hernia not possessing too broad a base the parts are first carefully replaced (the animal having been placed on its back and the hind-legs bent), and a ligature passed around the neck of the sac. Esser recommends for this purpose the elastic ligature. When, ten to twelve days later, this falls off, together with the hernial sac, a cicatrix has formed in the position of the latter, which prevents prolapse of the bowel. The elastic ligature should, however, not be drawn tight enough to cut rapidly. To prevent its sliding off, a strong needle may be passed through the sac below it.

Degive takes up as much as possible in the ligature, and draws this quite tight. According to him the method is very successful in ruptures where the abdominal opening is not of greater diameter than the thumb. Where the base is broad the cord easily slips off; removal by multiple ligature, *i.e.*, ligation in sections, is then preferable, and in foals, and even in older horses, gives good results. Procedure is as follows:—The animal is cast, placed on its back, the hind legs bent and drawn outwards, the hair shaved from over the hernial sac, and the latter washed and rinsed with a disinfecting fluid. After complete reduction, the folds of the sac are gathered together in the direction of its long axis, and, beginning at one end, transfixed close to the abdominal wall with a slightly bent needle,

provided with a strong sterilised double silk thread. The threads, when drawn through, are divided close to the needle, and the ends of the one half tied tightly together, whilst an assistant draws the sac gently upwards. The needle carrying the second half of the thread is again passed through the sac about $\frac{3}{4}$ of an inch from the first point of incision, and this section ligatured in a similar way. The same process is continued until the entire sac is ligatured. Should the animal struggle whilst the needle is being passed, the fingers of the left hand are placed on the umbilical ring to prevent the intestine protruding and being transfixed, or one waits until the animal is again quiet. The entire sac is then once more rinsed with sublimate or carbolic solution, and the ligatures on both sides of the sac powdered with a mixture of iodoform and tannin (1 to 3), or the entire sac may be painted with wound gelatine and covered with wadding.

The animal is now allowed to rise and placed in a stall provided with good clean straw. Should the above described precautions



FIG. 391.—Kühn's needle for ligation of the sac in umbilical hernia.

be taken, the wound generally heals aseptically. In from ten to fourteen days the ligatured portion of the sac sloughs away, and the wound appears healed. The operation is performed in a similar way at Brussels, but, instead of silk, strong waxed cords or hemp threads are employed. To facilitate the work of ligation French veterinarians use an iron clam, which is applied over the empty hernial sac close to the abdominal walls. It prevents the portions of bowel which enter the sac when the animal struggles being penetrated by the needle. This may just as easily be avoided by chloroforming the animal, or by carrying out the above described method.

To prevent prolapse of the viscera during multiple ligation, Mangot employs a long rectangular plate of lead, which has an opening in the centre through which the empty sac is drawn and then ligatured. Two wooden pegs are then thrust through the skin below the thread, the sac is cut off, and the plate of lead fastened over the animal's back by four straps, which pass through suitable holes at the corners of the plate. Imminger has lately introduced this method in foals, but he employs silver wire for ligation. If the wire is not too thin, and not too strongly pulled, prolapse of bowel does not occur.

(b) Removal of the sac by clam. The clam acts like multiple ligation and is most useful in hernia with a broad base ; but, although this method is simpler than ligation, it usually prevents healing by first intention. To prevent the clam falling off too soon, needles are passed through the sac below the clam, or a clam with serrated edges may be used. With this object in view, Bordonnat constructed the iron toothed-clam shown in Fig 392, and Combe invented a perforated clam (Fig. 393), which allows the passage of ligatures or



FIG. 393.
Combe's clam.

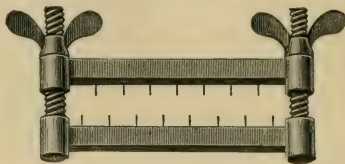


FIG. 392.—Bordonnat's clam.

strong needles through the sac. After reducing the hernia, the clam is applied to the neck of the sac, as near as possible to the under surface of the belly, and in the direction of the linea alba, and fastened by screws, or, as in castration, by a cord. Whatever the method employed, the following symptoms almost always appear :—During the first few hours after operation there is slight colic. Next day signs of inflammation become apparent : the umbilical region is swollen and painful ; the hernial sac is cold, purple in colour, and insensitive ; appetite is in abeyance and fever is present. Towards the fourth day the skin becomes necrotic ; the clams separate and fall about the twelfth to the fifteenth day, leaving a considerable wound and much local swelling, which disappears slowly. In three weeks to a month the umbilical opening should be obliterated. In

cases of very wide umbilical ring, however, recurrence of the hernia has been noted even after the above treatment.

The chief points in using clams are to grasp sufficient skin, and to fix the clam evenly and firmly, though not tight enough to induce immediate necrosis. Iron clams provided with screws are preferable to wooden clams, because they can be gradually tightened and more evenly applied.

In using wooden clams, Degive recommends, especially for large herniæ, the application of two clams, one above the other ; the upper

one should be about 12 inches long, the under one 4 inches less. The upper clam is applied as close as possible to the belly, so that after the animal rises, the sac appears to have vanished. Herniæ as large even as a man's head may be completely cured by this method. Demesse states having thus cured a case where two hands together could be passed through the umbilical ring. Should the sheath in male animals reach so far forward that it would be touched by the clam, the latter may be applied at right angles to the long axis of the body.

(c) *Herniotomy.* When, as in very large herniæ, the above methods fail, a cure may possibly be effected by suturing the hernial ring. Cordelier gives the following indications for this operation:—
1. Strangulation. 2. Large size of the hernia. 3. Long existence of the hernia. 4. Impossibility of reducing the condition. 5. Adhesion of the contents to the hernial sac. 6. Inflammation of the hernia, or the existence of colic. The operation is carried out as previously described, and under antiseptic precautions. The animal is chloroformed, laid on its back, the entire surface shaved, rinsed free of soap, and disinfected. The skin is then divided in the long axis of the hernia or of the hernial ring. From this point the operation may be completed either with or without opening the peritoneal cavity. Siedamgrotzky prefers the latter way, and next separates the skin from the hernial sac, which he thrusts into the hernial opening. The edges of the umbilical ring are then freshened, brought together with strong silk threads, and the flaps of skin, after being shortened to the necessary extent, united above them. An antiseptic dressing is secured over all by means of bandages or a few threads, and healing takes place completely in from twenty to thirty days. Catgut is here unsuitable, as it is too quickly absorbed. Guttmann had five relapses among twenty cases from this cause.

Storry proceeded in a similar way. After dividing the sac from the skin, he sutured it with a strip of white leather, then cut it off and sewed the skin together.

This method is to be preferred to internal herniotomy (which necessitates opening the peritoneal sac), if for no other reason than that the risk of peritonitis is less, and success is not endangered by prolapse of portions of intestine or omentum. It must, however, not be forgotten that in many cases the peritoneum cannot be separated from the surrounding tissues, especially at the base of the hernial sac, and that the peritoneal cavity is apt to be opened in making the attempt. Nevertheless bad results seldom occur.

The peritoneum may be incised without grave risk as shown

by various observations : Degive operates in this way, and Wiesner and others have reported cases, though it is clear that healing is not so simple as in Siedamgrotzky's method. Fröhner operated under strict antiseptis, sutured the abdominal wound, and effected healing by first intention in ten days.

Should the hernia be adherent, which is not uncommon after the use of acids or other irritants, it is better to limit the opening in the peritoneal cavity. Degive proceeds as follows :—The hernial sac is opened under antiseptic precautions and the peritoneum cut through only far enough to admit the finger, so as to separate the adherent portions ; scissors may also be used. The sac is afterwards ligatured in sections, as above described. (For another method see section on "Ventral Hernia.") The cutting operation is not suitable in large herniæ, especially if the rupture be circular, because of the difficulty in uniting the edges of the ring ; in such cases it is better to transfix the hernial sac with stout needles or skewers, and apply a ligature between the needles and abdominal wall, or to use irritants supplemented by bandages.

The animal should be prepared for operation by reducing the diet, giving easily digestible and concentrated food, and administering a purgative to empty the bowel. Similar dietetic precautions should be continued for some days after operation.

In small animals (dogs) irritants cannot be employed on account of their being licked off. Operative interference is here easier, but it must not be forgotten that many animals will not endure bandages, clamps, threads, &c., but will at once tear them off. In the dog the radical operation under anæsthesia is preferable ; and to keep the patient quiet for 24 hours a strong dose of morphine should be given after operation.

VII.—INGUINAL HERNIA, SCROTAL HERNIA (HERNIA INGUINALIS, HERNIA SCROTALIS).

PASSAGE of abdominal contents, bowel, omentum, or both, through the inner abdominal ring into the vaginal sac constitutes inguinal hernia. Should the viscus attain the scrotum, the condition is termed scrotal hernia. The horizontal position of the body in domestic animals is less favourable to the production of inguinal hernia than the upright one in man. It occurs in horses and pigs, seldom in ruminants and dogs, and the sac usually contains intestine, less frequently omentum. As inguinal hernia exhibits certain peculiarities in the different classes of animals, it will be considered separately in each.

(1.) INGUINAL HERNIA IN THE HORSE.

IN stallions the inguinal canal consists of a flat funnel-shaped passage about 4 inches in length, whose upper opening (annulus abdominis) is from $\frac{3}{4}$ to $1\frac{1}{2}$ inches in length, but occasionally much wider. It extends in an oblique direction from behind outwards and forwards, is situated 1 to 2 inches from the oblique branch of the os pubis, and 4 to 6 inches from the linea alba. The vessels supplying the posterior portion of the abdominal walls pass about $\frac{3}{4}$ of an inch from its posterior angle, and on its inner side. The inguinal ring or outer abdominal ring (annulus inguinalis) consists of a slit between the inner and outer tendinous heads of the external oblique abdominal muscle, whose posterior inner angle lies $1\frac{1}{4}$ inches in front of the os pubis, and somewhat further from the middle line of the abdomen. The anterior inner wall of the inguinal canal is largely formed by the inner oblique abdominal muscle, the outer by the crural arch or Poupart's ligament.

Causes. In stallions with abnormally wide abdominal rings, and less frequently in geldings, the small intestine or omentum may enter the inguinal canal. According to Berdez, Vogel, Stockfleth, and others, the condition is always caused by excessive width of the ring; whilst Lafosse, H. Bouley, and Gerlach declare that inguinal hernia may occur even where the aperture is of normal width. But even if we allow this, there is no doubt that in by far the greater number of cases the condition is due to abnormal width of the ring, which sometimes measures 4 to 6 inches. Möller has, however, also seen inguinal hernia in horses in which the inner ring scarcely allowed the entrance of two fingers, though, as a rule, two easily pass in addition to the spermatic cord. It is therefore difficult to fix a normal width and settle this question, which requires numerous measurements to be made in different races of animals. Inguinal hernia is generally congenital, or appears during the descent of the testicle. The tendency to it seems to be inherited. Its production is favoured by all circumstances which cause increased abdominal pressure, such as tympanites, severe exertion, hard drawing on soft ground (where the action of the muscles in lifting the feet also produces dilatation of the abdominal ring), or struggling in hobbles. Hamerschmid's case shows that difficult birth may produce inguinal hernia in the foal, particularly in delivery with the hind-quarters presented; the foal in question showed an inguinal hernia as large as a child's head on the third day after birth. All movements which cause dilatation of the abdominal ring, like violent kicking or slipping, especially slipping outwards and backwards, may give rise to inguinal hernia. The same result may be produced by dragging on the spermatic cord during castration, by the pull of a heavy clam, or of

a largely developed testicle in old stallions. In the latter, inguinal hernia sometimes results during copulation, the erect position causing the viscera to be pressed towards the pelvis and into the inguinal canal, which is dilated in consequence of the thighs being turned outwards.

The condition is rare in geldings, because it is either cured by castration or leads to the death of the animal, and because dilatation of the abdominal ring very seldom happens late in life. The earlier



FIG. 394.—Incomplete inguinal hernia. (The fig. shows the position of the inner abdominal ring and the course of the external pudic artery.)

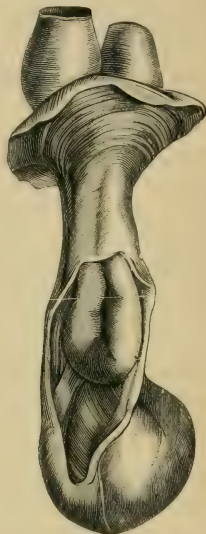


FIG. 395.—Inguinal hernia of the horse. (Hering.)

the colt is castrated the smaller does the inner abdominal ring become, and this explains why it is so small in most geldings, though the latter are not exempt from inguinal hernia. The swelling of the spermatic cord after castration distends the canal and favours hernia ; the contents are usually intestinal, but omental hernia also occurs, though in stallions intestine is much more frequently found. Sometimes both intestine and omentum are present in the sac which is formed by the tunica vaginalis reflexa, dartos, and skin.

Symptoms. The scrotum is increased in size by the entrance of the viscus, but to a very varying degree ; in cases a careful search may

be required to detect the rupture, while in others the swelling extends below the hocks, and attains the size of a sugar loaf. Degive saw a hernial sac, 16 inches in depth and 8 in width, containing 27 pints of fluid, and others as large have been seen.

The swelling has the general characters of a hernia, is elastic, soft, and, if omental, somewhat doughy. It is yielding, and disappears on pressure, or on the animal being placed on its back, leaving the sac empty except for the testicle, which, in old inguinal herniæ, is usually artrophied and flaccid. A coil of intestine may sometimes be detected in the scrotum, and, according to Boulet, always lies on the inner side of the spermatic cord. The swelling is increased by exertion, by the action of the abdominal muscles, or by coughing. Rumbling and a tympanitic tone on percussion betray the presence of gas.

The detection of so-called incomplete inguinal hernia is very difficult. The spermatic cord is usually abnormally thickened, either from œdema following pressure by the hernial contents on the vessels of the cord, or from hypertrophy of the cremaster in consequence of increased work. The former is therefore commoner in recent inguinal cases, the latter in old ones. Doubtful cases can be cleared up by a rectal examination.

In recent inguinal hernia with commencing compression, the hind-limbs are generally moved stiffly, the toes dragged, and the limbs turned outwards, the breathing is rapid, the animal stretches out, shows slight colic, and draws up the testicle of the affected side; Girard regards the latter symptom as pathognomonic. These signs either vanish in a few days, or symptoms of strangulation set in.

In inguinal, as in other herniæ, strangulation is generally first signalled by attacks of colic, and therefore it is a good practical rule always to examine the scrotum and internal inguinal ring in stallions suffering from colic. The horse, under these circumstances, usually stretches out or sits on its hind-quarters like a dog. Jessen saw vomiting, and though, as a rule, this only occurs in disease of the stomach, it must not be forgotten that gastric rupture may accompany or follow intestinal strangulation.

A second group of symptoms indicative of incarceration are found in the changes undergone by the scrotum. The hernial swelling becomes larger, harder, tenser, and more painful, and can no longer be compressed or displaced. In several of such cases the epididymis has appeared very prominent close to the testicle.

Diagnosis of inguinal or scrotal hernia or strangulation is therefore seldom difficult. The conditions most resembling it are :—

(1) So-called interstitial inguinal hernia. This condition will later be referred to.

(2) Scirrhus cord, though the greater hardness of the entire swelling scarcely allows of mistake.

(3) Hydrocele. Collection of fluid in the vaginal sac may be recognised by the swelling being easily displaced and occupying the lower portions of the scrotum. Hydrops of the spermatic cord may be at once recognised by its greater firmness and immobility, and can only be mistaken for incarcerated hernia.

(4) Hæmatocele, that is, distension of the scrotum, or of the tunica vaginalis, with blood, presents the same appearances as hydrops, but is often associated with œdema of the scrotal skin.

(5) Inflammation of the skin covering the scrotum may, under certain circumstances, give rise to suspicion of inguinal hernia, and in all such doubtful cases examination per rectum must be resorted to, when it is easy to determine whether or not bowel has entered the inguinal canal.

(6) Tumours of the spermatic cord and testicle develop slowly, and are not dissipated by pressure.

Course. In foals, spontaneous recovery often occurs, though seldom later than the second year of life. Gross believes that good feeding favours recovery, by producing a better muscular tone; and distension of the intestine with firm contents, consequent on hard diet, certainly assists reduction. On the other hand, the rupture may gradually increase, particularly if work is heavy and the food bulky, and in such cases incarceration often occurs. Cases like Brinhall's in a three-year-old stallion are, however, very rare. He saw a scrotal hernia suddenly develop, and two weeks later break, in consequence of necrosis of the sac. An intestinal fistula was thus produced, but closed again in a month without any assistance. Perhaps this was a case of strangulation, but the result was certainly very extraordinary. In exceptional cases inguinal hernia appears in old animals and generally soon becomes strangulated. Such cases are probably often due to a simple inguinal hernia developing into the scrotal form, the former having been overlooked. In stallions scrotal hernia may become so large as even to interfere with movement of the hind-limb, or be injured by it.

Prognosis. Inguinal hernia is always dangerous, because treatment is difficult, and death often follows strangulation. The most important elements in forming a prognosis are the age of the animal, and the size and character of the hernia.

Spontaneous recovery is rare in adults though common in young

animals. The condition produces difficulty in castrating foals, and renders this generally simple operation dangerous, whilst recent inguinal hernia in old animals is doubly grave, on account of the risk of incarceration. Extensive ruptures, and especially those with large apertures, not only injure the appearance of the animal and interfere with its use, but at the same time offer the greatest difficulty to treatment.

Omental are usually less grave than intestinal herniæ, and on this ground geldings are more hopeful subjects, though even in them the intestine sometimes descends and becomes strangulated. In a gelding Möller replaced an incarcerated inguinal hernia four times during a period of six weeks. Irreducible herniæ are doubly dangerous, because of the difficulty in operating. Finally, it should be remarked that incarceration does not necessarily depend on the size of the hernia. A small and incomplete inguinal hernia is more frequently strangulated than an extensive hernia with wide abdominal ring.

Treatment. Operation is rendered difficult by the length of the inguinal canal and the position of the hernia. Hering very shrewdly advised leaving well alone, and not operating unless obliged. This, however, becomes necessary when a stallion has to be castrated, and incarceration not infrequently necessitates operation. As, in the latter case, procedure differs from that in non-strangulated ruptures, the treatment of the simpler condition will first be dealt with.

(A) TREATMENT OF NON-STRANGULATED INGUINAL HERNIA.

Various methods have been proposed ; amongst the more important are—

(1) Treatment by closure or narrowing of the vaginal sac.

(a) Foelen recommends the application of **irritants** to the scrotum in the neighbourhood of the inguinal ring, as in treating umbilical herniæ. The ointment he uses consists of 1 part of cantharides, 2·5 parts of euphorbium, 15 parts of fat, and 1·5 parts of verdigris ; it may be applied without casting the animal by drawing the testicle downwards, thus rendering the skin of the scrotum tense. The application should be made once daily, until the epidermis becomes loosened, which usually happens in ten to twelve days. The parts are then washed with lukewarm water, and when the inflammation has disappeared the infrictions are recommenced, until in four to six weeks the rupture has disappeared. Degive also recommends this method, though it is of little use in animals more than four to six months old.

(b) **The application of a clam.** This is very generally practised, and resembles the covered method of castration. The hernia is reduced and the clam applied as high, that is, as near to the inguinal ring, as possible, and over the tunica vaginalis reflexa and spermatic cord. In order to be able to apply the clam very high it has been recommended to give it a bent form, but this is not desirable, because the centre portion does not press sufficiently on the tunica vaginalis. A simpler and more effectual way of closing the tunica vaginalis above the clam is to give a half turn, which may later be made a complete one, to the tunica vaginalis and spermatic cord before applying the clam.

Recurrence of the hernia is prevented by the formation of adhesions between the two vaginal coverings of the cord; but where the abdominal ring is large, partial recurrence may follow operation, and sometimes in the foal owing to tissue weakness, the external tunica vaginalis ruptures above the clam. Though the danger of post-operative recurrence is certainly decreased by twisting the cord and tunica vaginalis, it is not entirely removed, and therefore the technique has been somewhat modified by different operators. The operation should be performed aseptically and under chloroform. A short but carefully disinfected clam is selected, and an incision made through the skin, large enough to allow the clam to be pushed to the bottom of the wound, and to be secured just under the external inguinal ring. The skin is then brought over it and sutured, thus retaining the clam in the wound. If neither fever, swelling, nor other disturbance is marked during the next few days, the clam is allowed to remain in position for a week or longer. On removal, healthy granulations will be found unaccompanied by pus formation, and usually the wound heals in a short time under antiseptic precautions.

Stockfleth operated in a similar way. He drew the lappets of skin over the clam, by means of purse-string sutures, but loosened the latter next day, and applied a ligature around the tunica vaginalis and above the clam. If this be not done, it is well to fasten the clam to the neighbouring skin by a ligature.

Sörensen and others apply a ligature above the clam for a similar purpose. The clam is removed next day, but the ligature is left in position until it falls off.

The clam must not be removed too soon. The longer it remains the better the union between the surfaces of the vaginal tunics. Jessen found three days too little, and in his later cases left the clam on for five days. In the above operation the clam may remain in

position ten days or longer without disadvantage, and need not be removed, even though pus form, provided there is no constitutional disturbance. Some operators prefer to allow the clam to fall off, which usually happens between the tenth and fifteenth days. Removal of the clam before firm adhesion has been established between the vaginal coverings is a frequent cause of failure of the operation. When the clam falls off too soon prolapse of the bowel occurs and the patient may die from peritonitis.

Dieterichs recommends using a sterilised sponge temporarily to close the tunica vaginalis. He opens the latter, ligatures the spermatic artery, and then thrusts a sponge, provided with a central hole, over the spermatic cord, and as high up as possible, so as to occlude the abdominal ring. The clam is then applied to the spermatic cord, but removed again after twenty-four hours, whilst the sponge is left in position until it comes away spontaneously. The disadvantage is, that should the sponge not be carefully sterilised, which is very difficult to ensure, peritonitis occurs, as shown by the experience of Bassi and others, and for this reason this method cannot be recommended; that above described is certainly to be preferred.

(c) The method of **ligaturing the tunica vaginalis** with the spermatic cord, though quite safe and effectual, has not found many supporters. The ligature may not produce such perfect occlusion as the clam, but when aseptic materials like braided silk, thick twist, or $\frac{1}{8}$ inch tape are employed, the vaginal sac can be closed very securely and somewhat higher on the cord. Two ligatures are applied; one is doubled and passed through the substance of the cord close to the inguinal ring, the loop is then cut and the ends are tied on each side; the other ligature is passed two or three times round the covered cord, just below the first ligature and securely tied.

(d) Bouissys's plan of **multiple ligation of the scrotum** is inadvisable, because of the danger of including a portion of bowel, and to prevent this (even when using the clam over the tunica vaginalis), it has been suggested to first incise the tunica, and, by introducing the finger, to make sure that no intestine is present. This may be useful in doubtful cases, but an external examination generally suffices.

(2) **Closure of the internal inguinal ring.** Many operators describe having sutured the *inner* abdominal ring, but as the *modus operandi* is never sufficiently well described to convince one of the correctness of the assertion, the point must remain doubtful. In old stallions the narrowest portion of the inguinal canal lies $\frac{3}{4}$ to $1\frac{1}{4}$ inches below the internal ring, and presents an almost insuperable difficulty. If the inner abdominal ring has ever been sutured, an abnormal condition of the parts has clearly existed, to begin with. On the other hand,

the position of the inguinal ring (*i.e.*, the outer ring) would easily allow of its being sutured, but the rigid character of the edges (aponeurosis of the external oblique muscle) effectually prevents union. Certainly the same success could not be obtained as by the above described methods, and this probably explains its slight popularity.

(3) **Closure of the inner abdominal ring by inducing inflammation** of the spermatic cord and adhesions with neighbouring structures. If, after successful reposition of the hernia the spermatic cord be caused to swell, it may completely fill the internal ring, or so far occlude it as to prevent the passage of intestine or omentum.

(a) In Spain, according to Stockfleth's description, the scrotum and spermatic cord are continuously rubbed. The stallion is starved for two or three days, the rectum emptied by means of clysters, the animal cast, placed on its back, and the hind-quarters drawn up. The testicle is now drawn forward with one hand, whilst the thumb, index, and middle finger of the other are employed in rubbing the spermatic cord until marked swelling appears. The animal is allowed to rise quietly, and during the first three days is sparingly fed, and only walked when exercised. Animals are said to be cured in twelve days; but though this is possible, it is certain that failures often result.

(b) Bagge's method is similar. After replacing the hernia, a woollen band is tied round the scrotum in the neighbourhood of the inguinal ring, and allowed to remain on for eight hours, when a swelling is found to have been produced, and the band is removed. Recovery occurs in six to eight days. Bagge states having thus cured nine stallions in one day (?).

In this connection, Kruckow's procedure may be referred to even though the method be not usually possible. In a fresh case of inguinal hernia Kruckow thrust the displaced portion of intestine, together with the testicle, back into the abdominal cavity, after which the intestine did not return. The scrotum was rubbed with diluted sulphuric acid. This report is open to question, for two reasons—firstly, it is certainly only possible in exceptional cases to thrust the testicle into the abdominal cavity through the inguinal canal, and even if this were always practicable, the absence of the spermatic cord from the abdominal ring must greatly favour recurrence.

In the **gelding**, operative measures must be somewhat modified. The horse is cast, chloroformed, laid on its back, and the hernia reduced; the castration cicatrix discovered, and an elliptical incision made through the skin around it, so that the skin which is adherent to the base of the tunica or end of the spermatic cord can be lifted

by means of a narrow tape passed through it. The hernial sac, which may be $\frac{3}{8}$ inch in thickness in chronic cases, is then separated as in the operation for scirrhus cord, and exposed for a considerable extent in an upward direction. The clam or ligature is now applied over the vaginal tunic and spermatic cord in the manner above described, provided no intestine is present in the hernial sac; but as one must, in the gelding, always be prepared for adhesions, it is best where the slightest doubt exists to open the sac, and by introducing the finger to make sure of the absence of intestine or omentum. To prevent injury, the intestine must be separated with the greatest care. For this purpose the scissors are most useful; and if possible the border of the adherent bowel should be found, and where this cannot be clearly made out, a portion of the wall of the sac can be left adhering to the surface of the bowel and the two replaced together. Pieces of omentum may be ligatured with sterilised material and cut off, or they may be included in the clam without danger. Strecker, in operating on a gelding, used a ligature to close the tunica vaginalis.

(B) TREATMENT OF INCARCERATED INGUINAL HERNIA.

This must be carried out as early as possible, and in conformity with the general precautions mentioned under "Treatment of Strangulated Herniæ."

The horse is carefully cast, chloroformed, and laid on its back, the hind-quarters being higher than the fore, which Jessen effects by laying the fore-part in a hollow; the hind-legs are bent, and, if possible, the leg of the affected side is drawn outwards and backwards. One then endeavours, by pressing on the neck of the hernial sac, and by drawing and turning as described (*vide loc. cit.*), to effect taxis, the testicle meanwhile being drawn forward. Reposition may be effected by introducing the hand into the rectum and cautiously pulling on the parts in the inguinal canal, but caution must be used in manipulating the hernial sac, and the older the strangulation the greater the care required.

After complete reduction, the animal is allowed to roll on to the sound side; the hobbles are loosened, and if the animal remain quiet, it may be allowed to lie for a quarter to half an hour, though it must not be forcibly prevented from rising.

If, after trying for half an hour, reduction cannot be effected, herniotomy is usually the only resource. For this purpose anæsthesia should be continued or reinduced; the hoofs of the hind-legs

carefully cleansed and covered with moistened cloths, and the hair and under-surface of the legs also moistened to prevent dust falling on the point of operation. If the latter has been cleansed, disinfected,



FIG. 396.—Herniotome.



FIG. 397.—Herniotome.

and all the requirements of antisepsis complied with, the skin and tunica dartos are carefully cut through as in the "covered operation," and separated from the external tunica vaginalis with the fingers, assisted by scissors, up to the point where the neck of the hernial

sac appears most markedly strangulated. This point lies in the inguinal canal a little below the internal abdominal ring, as Hering and French veterinarians have noted. Reduction may now sometimes be effected by introducing a finger into the inguinal canal and pressing and kneading this point, especially if an assistant pass his hand into the rectum and pull gently on the bowel. Möller prefers to carry out this accessory manipulation personally, because, whilst it is important to exercise a steady and regular pull on the portion of bowel in the inguinal canal, the spermatic cord must not be grasped, as it would limit the pull. With a little practice the parts may easily be distinguished through the rectal wall. Should these attempts fail, the operator must proceed to internal herniotomy, that is, incision of the tunica vaginalis and of the abdominal ring. The seat of incarceration may generally be felt by introducing the finger, and division must be made at that point.

According to Möller's experience, in old stallions strangulation occurs about an inch below the internal abdominal ring. In geldings, on the other hand, he has generally found the annulus abdominalis the narrowest point. Possibly the heavy pull of the testicle on the spermatic cord, which becomes fan-shaped in the abdomen, exercises some influence on the funnel-shaped, or, as the French call it, the "hour-glass" dilatation of the tunica vaginalis, which is most noticeable towards the inner abdominal ring. The continuous pull can without doubt produce a dilating influence of that kind, which would explain the greater predisposition of old stallions to protrusion of the bowel at the point indicated.

Girard constructed for this operation two long hernia knives, one in the form of a greatly enlarged straight tenotome, and the other in that of a bent tenotome. The ordinary herniotome (Fig. 397) may also be employed, or in case of need, a blunt-pointed bistoury. The abdominal ring must be incised near its anterior angle, and in an outward direction. Towards the middle line, and in the neighbourhood of the posterior angle, are certain blood vessels, which must be avoided, and any lengthening of the anterior angle is apt to be followed by tearing of the inner oblique abdominal muscle. Even when the point of incarceration has only been incised to the extent of two or three lines, reposition becomes easy, and indeed usually results from the pull of the abdominal viscera themselves. Paty recommends pouring extract of opium and belladonna dissolved in oil into the tunica vaginalis. This certainly lubricates the contents of the hernial sac and assists reposition; but plain oil sterilised by boiling would serve the same purpose. After reduction, treatment is the same as in non-strangulated rupture, that is, a clam or tape ligature is adjusted as high up as possible over the spermatic cord and

tunica vaginalis and the testicle removed. A description of several cases of acute inguinal hernia treated by operation will be found in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery."

Where it is important to preserve the testicle, the subcutaneous operation, recommended by Bouley, can be carried out, though the strictest asepsis must be observed. The scrotum and tunica vaginalis are cautiously opened at the outer side, in the neighbourhood of the inguinal ring, so that a grooved director may be introduced into the narrowest part of the canal, which is then incised with the hernia knife. Others use the fingers instead of a probe and pass the hernia knife along these to incise the abdominal ring. Siegen states having thus rendered a horse fit for work in twelve days. The outer wound is sewn up and a suitable antiseptic dressing applied. Unless strictly antiseptic, this method is open to grave objection, as Peuch has already pointed out; and, besides, it does not prevent recurrence of the hernia.

A bloodless method of operation which aims at preserving the testicle, but could only be used in very recent cases, is described by Bagge and Grünwald. The stallion is cast, rolled on its back, and anæsthetised. A mass of cotton wool saturated with chloroform is laid on the scrotum. The evaporation is said to cause rapid diminution in volume of the gas enclosed in the strangulated portion of bowel, and to allow of reduction in a few minutes.

In other respects the operation for inguinal hernia is not so grave. Bouley states having effected a cure after strangulation lasting twenty-four hours. According to Stockfleth, of 55 horses, 13 died after dilatation of the abdominal ring; in Alfort, 8 out of 20 died; but Benjamin only lost 5 out of 28 operated on.

(2.) INTERSTITIAL INGUINAL HERNIA. FALSE INGUINAL HERNIA.

This term is used to describe inguinal or scrotal hernia where the hernial contents lie outside the tunica vaginalis. A portion of the small intestine, colon, or very occasionally omentum, passes into the inguinal canal or scrotum, not through the inner abdominal ring, but through a rent in front of the abdominal ring. At this point in the abdominal wall of the horse a lacuna exists, which is filled with connective tissue, and is therefore less resistant. This section of the abdominal wall is lined with peritoneum, and is considered by Franck to be a tendinous expansion of the oblique abdominal muscle; by Schmalz it is termed the inguinal ring.

After rupture of the peritoneum and of this connective tissue, intestine or omentum may pass into the inguinal canal outside the tunica vaginalis, forming what is termed "peritoneal-scrotal hernia" (Fig. 398). The condition clearly has a great resemblance to true inguinal hernia; but the swelling appears higher up, close under the inguinal ring, because the hernial contents are not confined by the tunica vaginalis, in consequence of which the base of the hernial sac appears more pointed, and may take the form of a peaked night-cap. Taxis is more difficult than in the previous condition. In doubtful

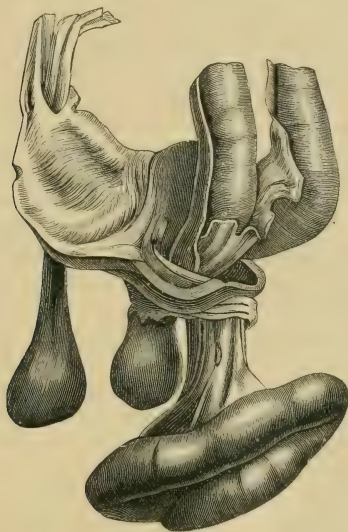


FIG. 398.—Peritoneal-scrotal hernia. (Hering.)

cases examination per rectum may give reliable information as to the character of the swelling.

The condition was discovered by Hildach during a post-mortem on a stallion, and has been described by H. Bouley in France as "*hernie extra-vaginale*." Sometimes it is first recognised when performing the operation for inguinal hernia, the contents of the hernia, and not the tunica vaginalis, coming in view on incising the scrotum. Stockfleth saw it in boars, but it seems unknown in other animals. The first change consists in rupture of the above-described portion of the abdominal wall, probably from abnormal increase

in intra-abdominal pressure, or from violent movement. Hildach saw this form of hernia suddenly occur after the animal had been ridden.

Prognosis is even less favourable than in true inguinal hernia, the danger of incarceration being greater, and recovery attended with more difficulty, because the tunica vaginalis cannot be drawn forward to effect closure of the hernial opening.

Treatment. Where strangulation has not set in, operation should be avoided. Reduction of incarcerated hernia may be attempted in the standing position, but usually fails, even when assisted from within by a hand introduced into the rectum. But under no circumstances should operation be attempted until every effort to effect reduction by taxis has failed. For this purpose the same measures may be adopted (casting, dorsal position, narcosis) as in true inguinal hernia. Should herniotomy prove absolutely necessary, the scrotum is cautiously opened under antiseptic precautions. After dividing the skin and tunica dartos, the hernial contents appear, and must be protected from soiling by cloths dipped in disinfecting fluids. The hernial opening is then sought for with the index finger, which is guided by the hernial contents, and should it prove impossible to dilate the aperture with the finger, and return the intestine to the abdominal cavity, the opening must be widened with a herniotome, after which taxis becomes easy. An attempt may then be made to close the opening in the abdominal wall with sutures of sterilised silk. The wound of the scrotum is closed with button sutures cleansed and covered with a dressing of iodoform and tannin. Lund operated on an interstitial inguinal hernia with success; but Hering noted prolapse of the bowel, and death after operation.

(3.) INGUINAL HERNIA IN RUMINANTS.

Inguinal hernia is rare in ruminants, and only a few recorded cases exist. Youatt saw it in a steer, Löble in an ox, Hess in a calf, Rychner in a cow, Lafosse in a male goat, and Lenguenard in a lamb.

The symptoms and course of the disease are similar to those in horses, though the condition is far less grave than in the latter—the value of the animal not being diminished to the same extent, and it being possible, even where the hernia has become incarcerated, to slaughter without very great loss.

Treatment is much as above described. Should the hernia become strangulated, Löble's method of operating through the right flank may be tried. He thrust the ox against a wall, cut through the skin

and muscle below the external angle of the ilium, passed the hand into the abdominal cavity, and found a double loop of intestine strangulated in the left inguinal canal. As this could neither be freed, nor could a finger be introduced into the inguinal canal, Löble inserted a straight bistoury (whose point was guarded with a strip of plaster), holding it between the index finger and thumb, and thus enlarged the abdominal ring. A tenotome is recommended for this purpose, and it should be fastened by a cord, so as not to be lost in the abdominal cavity. After freeing the bowel the abdominal wound was sutured, and recovery occurred in six weeks. It should not be forgotten, however, that the hernia can often be reduced *via* the rectum, without opening the abdomen.

(4.) PERINEAL HERNIA IN SWINE.

Both boars and castrated swine may be affected with perineal herniæ. The hernia is generally one-sided, very seldom double-sided, and its contents usually consist of a portion of bowel which, in castrated animals, is often adherent to the sac. Omental hernia is rare. In swine perineal hernia is usually congenital and hereditary, or develops during the first few weeks of life, seldom later.

Symptoms and course. In sucking pigs the swelling may be the size of a man's fist. The testicle lies at the bottom of the scrotum, which, in consequence of the thin and yielding character of its skin, may be greatly enlarged. Raising the fore-quarters increases the swelling, raising the hind-quarters diminishes it; whilst thrusting the finger upwards into it discovers the existence of dilatation of the abdominal ring. Sometimes the rupture is so small as only to be detected on castration. The little animal fails to develop, whilst the rupture gradually increases in size; but spontaneous recovery is sometimes seen. Though strangulation is not frequent, it occasionally happens both in boars and castrated animals, and is associated with the same symptoms as in other animals—colic, increased hardness and pain in the swelling, and difficulty in replacing the hernia.

Prognosis is more favourable in pigs than in horses, the peritoneum being less sensitive and not resenting operative interference to the same extent, though castration of a ruptured boar requires particular care, and sometimes ends fatally.

Treatment. In castrating ruptured sucking pigs, the animals are placed for some days on short rations, and starved for ten to twelve hours beforehand. The covered operation is selected and

the ligature, which should be rather thick, applied as high as possible, and drawn moderately tight, but not sufficiently to cut through the tunica vaginalis, which might lead to prolapse of the bowel. To avoid this danger Stockfleth sutured the skin, whilst Gerlach inserted a deep interrupted suture.

Should the hernial contents be adherent to the tunica vaginalis they must be carefully separated, injury to the bowel being avoided. A case of Eberhardt's shows that even incision into the bowel is not always fatal in pigs. Meyer, in cutting through an adhesion, left a portion of tunica vaginalis adherent to the bowel, but had good results. On account of such adhesions the operation is usually more difficult in castrated animals than in boars. The second testicle may be removed at the same time. Stockfleth recommends examining the inguinal ring first; when this is too small to admit the finger, the usual method of castration may be adopted, otherwise the covered operation is preferable. In double-sided perineal herniæ in sucking pigs, both testicles may thus be simultaneously removed.

Imminger describes the following method which he has practised for thirty years. In uncastrated sucking pigs the scrotum is opened as in the covered method, and under antiseptic precautions; the testicle, together with the spermatic cord and vaginal tunic, is then twisted around its long axis, forming a spiral, whilst a finger, inserted into the canal, assists the operation. As soon as the twisting has extended as far as the outer inguinal ring the hernial contents will be found to have returned to the abdominal cavity, and the spermatic cord, still covered by the vaginal tunic, is ligatured with silk as close to the outer ring as possible. The ligatures should not be drawn too tight. The skin wound is sutured.

Should the hernial contents be adherent to the sac, or should the pig have been castrated and an abscess have formed in consequence, the vaginal tunic is opened, the adhesion broken down or the abscess opened, and the operation completed as above.

Old ruptured boars are castrated by the covered operation, clams being used, and either left until they fall off spontaneously, which occurs in one to two weeks, or after a similar time removed. The clams, which should be rather small, must be used on both sides, even though the rupture be only one-sided. Degive opens the tunica vaginalis to make sure of the complete return of the bowel, and applies the clam as high as possible.

After operation, the animals are placed in a dry stall provided with clean straw, and for some time receive short rations. Local

treatment is not necessary, nor, on account of the excitement of the animals, is it to be recommended.

Stockfleth saw a case of "peritoneal-scrotal" hernia in a boar; on operating, the bowel was found outside the tunica vaginalis. He therefore enlarged the skin wound, replaced the hernial contents, and ligatured the inner coats of the hernia (which consisted of firm connective tissue) at the same time as the tunica vaginalis. The animal made a good recovery. The case shows that, in opening the hernial sac, care should be taken to avoid injuring the bowel, lest a rupture of this sort should exist. Storch describes a hernia, involving the uterus, one of the Fallopian tubes and one of the ovaries in a sow; the hernia (inguinal) formed a long, oval swelling as large as a child's head.

(5.) INGUINAL HERNIA IN DOGS.

This hernia, although rare in dogs, is common in bitches, in which the inguinal canal gives passage to the mammary vessels and round uterine ligament, which are covered by connective tissue. The hernial contents generally consist of uterus sometimes containing embryos. In one case Stockfleth found four fully-grown *fœtuses*. Sometimes, however, portions of intestine and omentum, and even of the urinary bladder and spleen, are found in the sac, which is formed by connective tissue, or peritoneum and skin.

Inguinal hernia is only seen in bitches, that have already borne young, the increase in length of the round uterine ligament, and the widening of the abdominal ring, necessary to hernia formation, being effected by muscular action during delivery.

Symptoms and progress. The hernial swelling is least characteristic in bitches, being covered by the udder. It is harder, but less sharply defined than in males, is often as large as a man's fist, lies towards the back of the udder, and appears, both when single and double-sided, as a regular diffuse swelling. In thin animals, and where the udder is only slightly developed, the uterus may sometimes be felt in the depths; in fat animals, having well-developed *mammæ*, diagnosis is often rather difficult. The possibility of reduction, and the disappearance or decrease of the swelling in the dorsal position, are the most important symptoms.

It is only possible on superficial examination to mistake this condition for tumour of the udder, and it should be remembered that tumours scarcely ever lie so deep as does the hernial swelling. It is more difficult to distinguish it from thickened round uterine ligament

though the latter appears as a hard cord connected with the anterior border of the os pubis. In doubtful cases the vagina must be examined. Where the uterus lies in the hernial sac the vagina appears lengthened, narrowed or drawn towards the affected side or downwards, and often scarcely admits the finger, whilst its anterior portion is less movable than usual.

Incarceration and other complications threatening life are seldom met with. Even delivery is usually easy. Strangulation, however, when occurring, produces symptoms similar to those in other animals. Vomiting is occasionally seen.

Treatment by regulation of diet and the application of a bandage when not harmful is useless. The hernia remains or recurs, and there is danger of adhesions forming and even of incarceration. Surgical treatment should be adopted as soon as possible. The operation is not difficult and generally safe. It consists in reduction of the hernia and ligation of the sac. The patient is anæsthetised and placed in the dorsal position. The region is washed, shaved and disinfected. An incision is then made through the skin over the hernia; the sac is isolated up to the inguinal ring; and reduction having been effected, a silk ligature is applied as near the abdominal opening as may be possible. The sac below the ligature is excised, the wound, carefully disinfected and sutured, is covered with an adhesive plaster or a bandage. If the hernial opening is large it should be sutured, and if the uterus cannot be reduced after enlarging the hernial ring by shallow incision, directed forwards and outwards, partial amputation should be performed, or the abdomen may be opened and the entire uterus removed. In omental hernia that offers much difficulty in reduction, the sac may be opened, the omentum drawn forward, ligatured and excised. When the herniated uterine horn contains a foetus or more than one, and reduction or delivery is impracticable, the uterus should be incised and the foetus removed, and instead of closing the incision and reducing the hernia, partial hysterectomy may be practised by ligation of the base of the horn and amputation. Before returning the womb the wound should be lightly cauterised and any projecting mucous membrane carefully excised. Operation is not advisable during œstrum, or soon after delivery.

VIII.—CRURAL HERNIA.

CRURAL hernia is so rare that Girard altogether doubted its occurrence in the horse, and in spite of extensive experience, neither Möller nor Cadiot has met with a case. The elder Lafosse, Hertwig,

and others state having had to operate for crural hernia ; and usually it is said to have been seen in horses and dogs.

The crural canal (*canalis cruralis*) consists of a triangular space between the sartorius and iliacus muscles and Poupart's ligament, and lies somewhat nearer the mesial line of the body than the inner abdominal ring, but close behind it. It is occupied by the crural vessels, by lymph glands, and connective tissue, and is covered by the outer tendinous head of the inner oblique abdominal muscle, and by the peritoneum, by which the passage of abdominal viscera into the canal is prevented. Should, however, this covering become ruptured or dilated and a portion of bowel or omentum enter the canal, a crural hernia results.

Symptoms. The hernial swelling, which is usually small and flat, is found on the inner aspect of the thigh, at the point where the vena saphena leaves the surface. It causes a straddling gait, and when incarcerated, may produce lameness, colic, &c. Examination in the dorsal position or per rectum leaves no doubt as to its existence.

Causes and progress. The condition is either congenital or arises during delivery, from the hind-quarters of the foetus remaining a long time in the maternal passages, and the abdomen being powerfully compressed. In later life it may be caused by slipping, drawing heavy loads, or by very severe labour pains. Dandrieux saw a cow develop crural hernia during labour. Spontaneous recovery scarcely ever occurs, and incarceration, which produces the same symptoms as in other herniæ, is not uncommon. Crural hernia must, therefore, be considered as at least as dangerous as inguinal hernia.

Treatment. Lafosse attempted taxis after casting the horse, but as the hernia was strangulated and taxis failed, he resorted to operation. An incision was made through the sac large enough to enable Poupart's ligament to be sutured to the long abductor muscle of the leg, after reduction of the hernia. After operation the animal was tied up for a week, and fourteen days later was quietly exercised.

Tidborn opened an incarcerated hernia in a foal, replaced the loop of small intestine, which had already become adherent, and sewed up the wound ; the animal, however, died. Lafond states having cured crural hernia in a she-ass by using a clam. In Germany the disease appears to be very rare. Whether the different food or the heavy work is the cause of its more frequent occurrence in France is uncertain.

IX.—PERINEAL HERNIA.

THE posterior wall of the pelvis possesses in male animals only one dilatation—the recto-vesical; but in female animals there are two—the upper the recto-vaginal, the under vesico-vaginal. Extension of one or other of these boundaries of the pelvis with entrance of abdominal viscera into the space so caused is termed perineal hernia.

This condition is most frequently seen in dogs, occasionally in the cow, ewe, and rarely in the bitch, in which animal it usually consists of a dilatation of the excavatio vesico uterina, which is more exposed to strain on account of its lower position. In male animals either the intestine or urinary bladder is found in the excavatio recto-vesicalis, in females the hernia consists of the uterus, omentum, bladder or small intestine. Frick, in the case of a pregnant cow, saw a portion of the gravid uterus in the sac.

Symptoms. In dogs a swelling, varying from the size of a man's fist to that of a child's head, and possessing the known characteristics of a hernia, occurs close to the root of the tail and just over the ischial tuberosity. In ewes it may be as large as a goose's egg, and appears alongside the vulva. In the cow a round swelling, sometimes as large as a man's head, arises close under the vagina, and presses forward the labiæ. The hernia can be reduced and the swelling dispersed by pressure, by raising the hind-legs, or by walking the animal down-hill; whilst it is increased by raising the fore-legs, or by any cause which increases intra-abdominal pressure. Incarceration very seldom occurs, though Siedamgrotzky noticed strangulation of the urinary bladder in a dog.

Causes and progress. Continuous contraction of the abdominal muscles, difficult parturition, heavy draught, walking on the hind-legs (dog), standing with the hind-quarters low (cows) and obstinate constipation are known to favour production of perineal hernia, but its immediate cause is a mystery. It may exist for long periods without causing trouble, for, on account of the great width of the hernial opening, incarceration is exceedingly rare, though, according to Stockfleth, it sometimes impedes delivery in ewes, because the vagina is pressed into the hernial sac during labour, and becomes more or less folded. Cows with this defect should not be used for breeding. In Frick's case assistance was required to deliver the calf as the fore-legs became fixed in the hernial sac. Dogs may have difficulty in urinating and the cause may be referred to the prostate. Doubt as to the nature of the swelling can be removed by exploratory puncture, employing a clean grooved needle or fine trocar.

Treatment. As a preventive measure, cows should not be placed with the fore feet higher than the hind. Unless strangulation occurs, all treatment should be avoided; the difficulties during labour are said to be lessened by dilating the vagina. Another reason for avoiding operation is that the hernial contents are often attached to the sac, a condition indicated by the latter being markedly drawn inwards when the hind-quarters are raised. Should incarceration necessitate operation, or the owner desire it, the animal is chloroformed, an incision is made in the skin over the swelling, and the hernial sac ligatured in sections, that is, if the contents of the sac are clearly non-adherent. Otherwise the inner coats must be cautiously cut through, the intestine or bladder separated, the sac brought together with several stitches, and the skin first shortened sufficiently and then sutured. A case treated in the Dresden clinique shows that it is possible to effect a cure, even under unfavourable circumstances, the urinary bladder had been incised, but was immediately sutured, and recovery followed. The purse-string suture may sometimes be used to advantage.

X.—VENTRAL HERNIA (HERNIA VENTRALIS).

WHILST the herniæ hitherto described are due to dilatation of natural openings, others caused by solutions of continuity in the abdominal walls (but not of the skin) are described as ventral herniæ. Such breaches are either caused by external injuries, like kicks, horn thrusts, the impact of blunt bodies, collisions with the carriage pole, staking of the abdomen, and falling on blunt objects, or they may result from excessive muscular contraction during parturition, &c. Sometimes they attain very large dimensions, as shown by Eberhardt and Dette's cases, and by a mare Möller had under observation (Fig. 399). Hertwig believed that congenital fissures in the walls of the abdomen sometimes caused ventral herniæ.

The structures forming the hernial sac vary with the position and extent of the rupture. In many cases the contents lie beneath the skin and panniculus or tunica abdominalis, sometimes immediately below the skin, the intestine or omentum or both having passed through a rupture of the peritoneum and abdominal muscles. The hernia usually contains intestine, though Noack reports two cases in the cow where it was above the udder, and contained portions of the uterus. One, operated on by Guittard, was in the right flank, and contained the abomasum. Gerlach and Schmieles have seen herniæ containing portions of the liver. A pig described by Frick,

which had died of double-sided hydronephrosis, showed just in front of the os pubis a hernial opening through which the bladder had slipped and become bent backwards.

Symptoms. In recent ventral hernia two sets of symptoms exist, those of hernia proper, and those of contusion; the latter may, indeed, appear the more important and mask the hernia. Ventral herniæ are found most frequently near the last rib, in cattle on the right, in horses on the left side. The parts are inflamed, painful

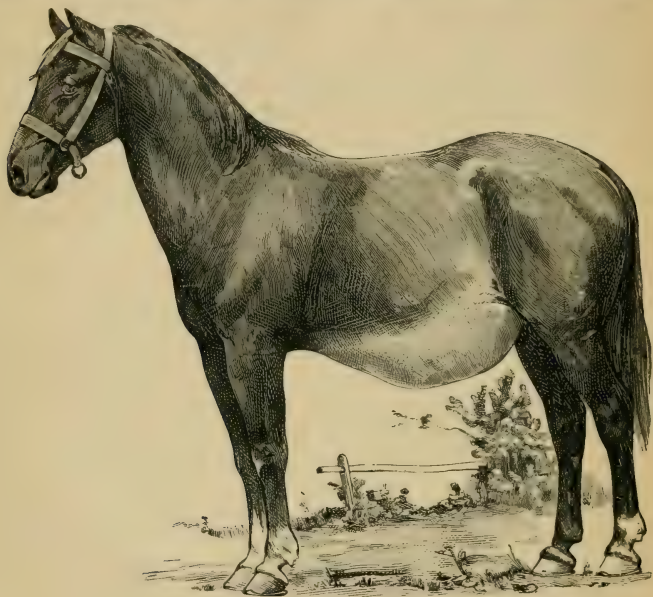


FIG. 399.—Ventral hernia in a mare (from a photograph).

on pressure, and, in consequence of œdema, either firm or doughy; if much blood has been poured out, there may be fluctuation. Older herniæ fail to display such symptoms, but will be recognised by their compressibility, fluctuation, softness, varying, size &c. In the depths, the hernial opening may usually be felt as a round or elongated aperture.

The swelling varies within wide limits; in small animals being often only the size of a pigeon's egg, while in cattle and horses it may exceed that of a sugar loaf. In the horse the hernia seldom

exceeds the size of the clenched fist or, at the most, of a man's head but greater dimensions are occasionally reached, as in the case of the mare shown in Fig. 399.

Differential diagnosis. Recent cases may be mistaken for inflammatory swelling, abscess or hæmatoma in the abdominal wall. In those of old standing the hernial aperture can usually be discovered by palpation, provided accidental inflammatory processes are absent from the affected region. Occasionally the hernial swelling (small intestine) is some distance behind or below the breach in the abdominal wall. The sudden appearance of the swelling and its compressibility must arouse suspicion of a rupture. In any case, caution is required in operative interference, and, in doubtful cases, sharp instruments should not be used before making certain of the absence of hernia. Rectal examination is sometimes useful, and, if needful, the parts can be punctured with a trocar, under antiseptic precautions.

Particular caution is indicated in presence of colic, which may proceed from incarceration, but in fresh injuries may also be caused by the pain associated with peritonitis; though the latter is the exception, the former the rule.

Frequently adhesions form, but strangulation is not at all common and some have denied its occurrence; but undoubtedly both recent and old ventral herniæ do occasionally become strangulated, though the danger is much less than in either umbilical or inguinal herniæ. The symptoms are similar in all. The necessary conditions are a small opening and a large sac. The immediate cause may be heavy work, tympanites, colic, or parturition, and it is common experience that the small intestine becomes more readily strangulated than the colon. Small ventral herniæ sometimes disappear spontaneously, and even large ones diminish with lapse of time.

Ventral are thus usually more hopeful than inguinal herniæ, though, by their position, they may seriously interfere with the use of harness horses, and are always a danger in the event of the animal suffering from colic or tympanites, or becoming pregnant; and, for this reason, female animals with ventral herniæ should not be used for breeding.

Treatment is best confined, in recent cases, to counteracting inflammatory symptoms, unless strangulation has occurred. Under favourable circumstances, the hernial contents may be replaced, or further egress prevented by a carefully applied compress; but it must not be forgotten that any considerable pressure may cause necrosis of the skin and favour prolapse. Old ventral herniæ seldom receive treatment, unless they interfere with the animal's work, when

the means advised for umbilical herniæ may be employed. Trusses can seldom be used, and treatment is then practically confined to the following :—

(1) Application of irritants or mineral acids. Rademacher recommends sulphuric acid.

(2) Simple or multiple ligation, or the application of a clam. This method presupposes the absence of adhesion, which, as already stated, is somewhat rare. Simple ligation is seldom successful, on account of the large base of the hernia, and therefore recourse must

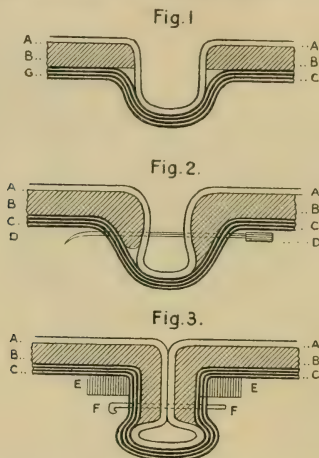


FIG. 400.—Schema illustrating Degive's operation for umbilical and ventral herniæ. A, Serous; B, musculo-aponeurotic, and C, cutaneous coats of the hernia; D, the special needle in place; E E, clam; F F, nails. The three figures show the successive stages of the operation.

be had to either multiple ligation or the clam, after making sure of the absence of adhesion. Either a wooden clam (castrating clam) or the iron one shown in Figs. 392 and 393 may be used, and the mode of application is the same as in umbilical hernia.

Degive has used the following method extensively in cases of ventral and umbilical herniæ. Under antiseptic precautions, he first opens the hernial sac in order to break down any existing adhesions, and then transfixes the skin and edges of the hernial ring with pack needles about 8 inches long. Above these he adjusts a clam, which is closed by means of a screw and firmly secured. The pack needles are then replaced by horse-shoe nails, the points of which are bent round. In about a week the necrotic tissue falls away, and

recovery occurs even in severe cases in which previous treatment had failed.

(3) Herniotomy. This only succeeds where the rupture is slit-like, and can be sutured. Jürgens reported several successes—in one the cow calved without any difficulty soon after operation; in another cow, showing symptoms of incarceration, Meyer sutured a recent ventral hernia in the neighbourhood of the udder. In old ventral herniæ extensive adhesions often exist between the contents and the sac, and occasion great difficulty to the operator; and whilst he must be prepared for this, he should use the greatest care in breaking them down. External Herniotomy sometimes succeeds, but not always, the inner hernial envelope, which has been retained in the hernial opening by means of the purse-string suture, sometimes failing to become adherent and the hernia reappearing later. In general, the larger the aperture the slighter is the hope of cure.

Incarcerations may sometimes be reduced by steady pressure from without, and assistants may even be entrusted with the treatment. It has been stated that in ruptures occurring in the posterior portion of the abdomen, reposition may be assisted in large animals by passing the hand into the rectum.

Gerlach and Schmiele operated on a dog suffering from fractured ribs, and a hernia containing part of the liver. A firm but compressible swelling, almost as large as a man's fist, had suddenly appeared in the left subcostal region. The hernial sac was divided, one lobe of the liver, which was found between the ribs, was replaced, the wound sutured, and a cure effected.

The mare shown in Fig 399 foaled without any help, in spite of the extensive nature of the rupture, the animal instinctively lying on the abdomen; it was then, however, killed, and the post-mortem showed that the straight abdominal muscle was ruptured a hand's-breadth in front of the os pubis, and that an aperture existed, measuring 20 inches in one, and 24 inches in the other direction. Both the oblique and transverse abdominal muscles were torn away. In the rupture lay a great part of the cæcum, its point directed backwards. Connective tissue had formed in all directions in large quantities, and the fascia of both thighs was greatly thickened as far down as the hocks; lameness had not been observed during life.

Guittard operated on a ventral hernia containing a portion of the abomasum, by incision through the flank. After thrusting back the abomasum the muscles were brought together, a dressing and compress applied and the case terminated successfully.

Cadiot and Dollar describe a ventral hernia in the left flank caused by a blow from the handle of a windlass. The abdominal tunic was ruptured opposite the stifle, and slightly above this point the muscles were torn through, leaving the herniated small intestine only covered by skin. After incision the hernia was reduced, the muscles and aponeuroses united by two separate lines of silk sutures, the skin was brought together and a dressing applied. In less than a month the wound had healed and the hernia was cured ("Clinical Veterinary Medicine and Surgery").

XI.—PELVIC HERNIA, “GUT-TIE.”

THIS affection occurs most frequently in hilly regions, like Switzerland, but has been seen in England and Denmark. Though first described by Oesterlen, it was left to Anker to explain the nature of the condition and its mode of origin. It almost always affects two to three-year-old oxen, occurs on the right side and results from a portion of the colon, or less frequently of the small intestine, becoming strangulated by passage through a rupture in the peritoneal covering of the spermatic cord. The bowel usually becomes fixed in an aperture of the peritoneum at the entrance to the pelvis and strangulated, though in other cases the free end of the spermatic cord returns into the abdominal cavity, and may encircle or become adherent to bowel in the neighbourhood of the abdominal ring.

Causes and progress. The immediate cause is a solution of continuity in the peritoneum covering the cord, or displacement of the cut end of the cord, though this is rare. Both conditions are due to unskilful castration, especially to pulling on the cord, without previously grasping it above, as in forcibly tearing off the testicles, a custom still common in the south of Europe.

The initial rupture is also favoured by heavy work in hilly districts. In climbing slopes, the viscera are pressed backwards, part may pass through the rupture existing in the peritoneum of the cord, and then become incarcerated. As the size of the rumen, which lies on the left, ensures it against strangulation, it is easy to explain the frequent occurrence of the condition on the right side. Failing early assistance, the animals die in four to eight days from incarceration, rupture of the bowel, or enteritis.

Symptoms. The condition is announced by colic, loss of appetite, constipation, striking with the feet at the abdomen, moving backwards, frequent lying-down followed by suddenly springing up, and general restlessness. Where much green food is given, tympanites may also be observed.

After twelve hours an apparent improvement sets in. The animals are quiet and may even ruminate and feed. During the next few days, however, they relapse; colic returns, the animal passes blood-stained fæces or mucus, has difficulty in breathing, and the pulse becomes small and frequent. As soon as these symptoms have appeared, the condition is in the highest degree threatening.

Sometimes pain is shown on pressure in the right flank, and on examination per rectum, a painful and doughy swelling, about as large as a man's head, which is at first soft, but later becomes hard, may be detected in front of the entrance to the pelvis and near the

wall of the abdomen. Towards the middle line it is bordered by a tensely stretched cord. In strangulation by the free end of the cord a similar swelling may be recognised on the lower abdominal wall, near the abdominal ring.

These symptoms leave little doubt as to the nature of the disease, though occasionally it may be confused with invagination of the bowel. Anker saw strangulation caused in one case by a hole in the round uterine ligament. Lindenberg states having seen similar symptoms from rectal obstruction. Examination of the rectum always gives the necessary information.

Treatment. In fresh cases reposition may be attempted by raising the hind-quarters or walking the animal down-hill, but little time should be lost in such attempts, because taxis becomes more difficult and dangerous the longer the malposition exists.

Reicherter and others have suggested performing taxis through the rectum. When the incarcerated portion of bowel is not much distended, this may succeed, but later becomes impossible. Whilst Reicherter states having thus cured sixteen animals, others have altogether questioned the efficacy or possibility of the operation. In making the attempt, the animal must be placed with the fore-legs lower than the hind; the loins pressed upon, to prevent arching of the back, the hand introduced into the rectum, and efforts made to thrust the strangulated bowel forward and so to free it. To prevent the animal lying down during operation a sack may be passed under the body and held on either side by one or two men, or the animal can be pressed against a wall by means of a long stout pole laid along the body. Others recommend rupturing the spermatic cord from the rectum. Schenk states having grasped the cord with the extended left hand, and having drawn it so far backwards that it broke in two; some operators recommend placing the thumb against it and pressing forwards to effect rupture. Whilst Anker states having thus invariably succeeded, others have failed to produce the desired rupture, and have proceeded to open the abdomen. For this purpose, an incision, about 4 to 5 inches in length, is made in the skin of the right flank, following the direction of the outer oblique



FIG. 401.—Anker's guarded knife for pelvic hernia.

abdominal muscle. After dividing the other muscles to the same extent, the peritoneum is broken through; the hand introduced into the peritoneal cavity, and a search made for the incarcerating spermatic cord, which is divided either with a *bistouri caché* or with a hooked knife. When the operator has convinced himself of the absence of a similar condition on the other side, the wound is sutured and treated according to general principles. If performed early, the operation is stated to be not dangerous. Strauss lost only 11 animals out of 110 subjected to operation; Kuhmann cured 112 cases in ten years; von Weil claims only to have lost 4 cases out of a total of 200; Anker records 44 recoveries. Caudwell operated successfully, on two steers, by opening the right flank and dividing the cord, which he found incarcerating the bowel in each case (*V. Record*, March 18th, 1911).

XII.—DIAPHRAGMATIC HERNIA (HERNIA DIAPHRAGMATICA).

RUPTURE of the diaphragm is commonest in horses, but also occurs in dogs and other animals, and is caused by sudden falls, collisions, street accidents, by rearing and falling over, and by severe tympanites; in exceptional cases, it occurs as a complication of fracture of the ribs. Abdominal organs may then pass into the thorax, a condition termed diaphragmatic hernia. The rupture may be in the muscular periphery or in the tendinous centre of the diaphragm. Lehnhardt saw this hernia in a cow; the reticulum had entered the thorax. In dogs the stomach, liver, or spleen may be found in the thorax; in horses the small intestine, stomach, or more rarely, the cæcum or colon. In horses, hernia through the muscle produces more disturbance than hernia through the tendinous centre. In the former hæmorrhage or strangulation may soon lead to death, whilst in the latter adhesions quickly form between the displaced viscus and the tendon and the patient may continue to improve; but irrespective of the position of rupture, when large masses of abdominal viscera enter the thorax, sudden asphyxia may be caused.

Symptoms and progress. In the absence of such fatal complications, difficulty in breathing is marked, the animals heaving as though broken-winded, owing to interference with the diaphragm, and ruminants show digestive disturbance.

It has been stated that the condition may be diagnosed with certainty by auscultation, but such is seldom the case. It is always difficult to say whether the peristaltic sound originates in the abdomen or the thorax, and, therefore, beginners may easily form an erroneous diagnosis. Nor can a tympanitic percussion sound be regarded as evidence of the disease, because this accompanies a series of changes

in the lungs, and in short no absolute diagnosis can be founded on clinical examination. The character and course of the symptoms and the absence of fever, though never pathognomonic, are perhaps the most reliable guides, though an exploratory puncture with Dieulafoy's aspirator may settle the diagnosis. Should the displaced viscus be penetrated, and fluid mixed with ingesta be drawn off, no doubt can then remain as to the condition.

Prognosis is always unfavourable and treatment unavailable, because even though reposition could be effected by performing laparotomy, the condition would probably recur, it being impossible to close the diaphragmatic opening.

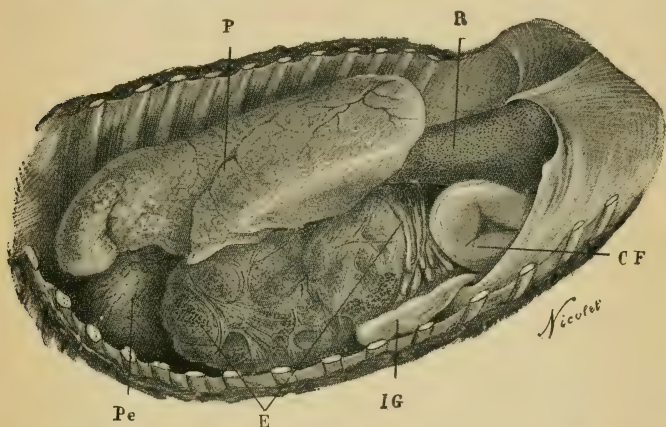


FIG. 402.—Diaphragmatic hernia. E, Epiploon; I G, loop of small intestine; C F, floating colon; R, spleen P, lung; Pe, pericardium.

Schrader saw an uncommon complication in the horse. The 7th rib was broken and a fragment had perforated the diaphragm, producing an opening through which portions of bowel, omentum, and spleen had passed into the thorax, and making their way through the thoracic wall and under the skin, had produced a hernia as large as a man's head just below the left elbow. The horse lived for several years, but finally died in consequence of the hernia becoming strangulated.

A case of diaphragmatic hernia is described in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery," and the condition is fully treated on pp. 44 *et seq.* of the same work. The case referred to is here illustrated (Fig. 402). The rent in the diaphragm had probably existed for many months, judging from the condition of its edges, but at first had only given passage to a few loops of small intestine and epiploon. Seven days before death the horse showed colic, but apparently recovered. Twelve hours before death, however, it had violent pain, which continued until the end. The gastric and splenic herniæ were probably produced at that time; soon after becoming herniated the stomach ruptured.

SURGICAL DISEASES OF THE STOMACH AND BOWELS.

I.—FOREIGN BODIES IN THE DIGESTIVE TRACT.

SHARP substances, like needles, wire, nails, &c., accidentally present in the food are sometimes swallowed by oxen, less often by sheep and goats, and give rise to injuries both of the digestive tube and of other parts, like the pericardium and heart. Horses are not so often affected, though in one case a quantity of nails, buttons, and screws were found in the colon of a horse, their corroded condition showing they had already lain there for a long time. Indigestion in calves and lambs is often produced by hair, twine, wool, or clover balls; and in pigs by bristles. Calves sucking cows fed partly on cotton cake or meal sometimes suffer from indigestion.

Dogs often swallow stones, corks, balls, or coins which they have picked up or had given them to carry; whilst in the stomachs of oxen and horses portions of probangs or balling-guns are sometimes found.

Hahn, while making a post-mortem of a horse, found an abscess in the spleen, containing a piece of wood 13 inches in length and $\frac{1}{2}$ inch in thickness. In one case a pig swallowed a castrating knife 4 inches in length, which remained lying in the stomach for two months without producing any marked disturbance. A similar experience in the dog is related by Iwersen. A sporting dog swallowed a pocket-knife while carrying it to its master, but vomited it again nineteen days later. Seven stones, of a collective weight of $5\frac{1}{4}$ ounces, were found in the stomach of a Newfoundland dog. The organ was greatly distended, its mucous membrane thickened and covered with warty growths. The dog had been accustomed to play with stones, tossing them into the air, and again catching them, and this had at length proved fatal, a piece of coal having blocked the ileo-cæcal valve and occluded the bowel. A cat swallowed a glass-headed hair-pin, $4\frac{1}{2}$ inches long. The head had entered the stomach, but the sharp end remained in the œsophagus, and led to perforation and death.

The danger thus occasioned is of a double nature: sharp foreign bodies, like needles, nails, &c., perforate the wall of the stomach or bowel, and lead to fatal peritonitis, or they penetrate the diaphragm and produce septic pericarditis. This is the rule in cattle, where such bodies enter from the reticulum. It often happens that, at the point of injury, the stomach or bowel becomes adherent to the abdominal wall, leading to perforation outwardly and escape of the

foreign body. The discharge of needles, hair-pins, and portions of wire has often been observed in cattle, and usually occurs on the left side, close behind the elbow. Avril removed a tobacco pricker, which had lain for six months in the ox's rumen, from this point. Recovery is generally perfect, stomach or bowel fistula being seldom produced. Sometimes the foreign body enters other organs, such as the spleen, and induces abscess formation, and death from peritonitis. Sheep and goats are less frequent victims, though cases of perforation of the abdominal walls and fatal peritonitis have also been seen in them.

Light foreign bodies, like hair and wool balls, remain lying in the stomach or lumen of the bowel, though heavy objects, like metal balls, knives, &c., often fail to pass the stomach. Sometimes they produce no discomfort, as in the case of a dog which swallowed a grape-shot, and in Nichoux's case, where the animal carried a silver five-franc piece and a large sou in his stomach for twelve years; but sometimes digestion is disturbed. Lighter foreign bodies obstruct the pylorus, or entering the bowel are apt to become fixed at the ileo-cæcal valve. Bottle corks are particularly dangerous, on account of their swelling in the bowel.

Symptoms and course. Patients are seldom directly observed when swallowing foreign bodies, and the presence of the latter in the digestive tract can only be discovered by the symptoms they give rise to. In cattle, the first sign of injury to the stomach is sudden unaccountable disturbance in digestion, with periodic colic and tympanites; dyspnoea soon follows, in consequence of injury to the diaphragm and lungs; irregularity in the action of the heart sets in later, the cardiac beat becomes laboured and intermittent; auscultation reveals pericardial murmurs, whilst the heart sounds still appear normal. To these are added rubbing, scraping, buzzing, or creaking sounds, or fluid sounds, like gurgling and bubbling. Circulation is impaired, oedema is present below the chest and in the dew-lap, and the jugular vein betrays pulsation (venous pulse). And lastly, palpation of the abdomen close to the ensiform cartilage towards the site of the reticulum, and in the heart region, may cause pain.

Sucking calves exhibit symptoms of abomasal indigestion, are listless, with a fever temperature (103° to 105° Fah.), breathing heavily and groaning; milk returns through the nose. After sucking these symptoms appear aggravated for a time, the abomasum being distended and painful to pressure. When arising from simple indigestion, improvement will follow in 12 hours, if a laxative be

given and the milk be diluted and restricted ; but, as a rule, no change for the better will be observed if a hair or twine ball be present in the stomach. In other cases premonitory symptoms are absent ; the calf is seized with a fit from which recovery takes place in a few minutes, and similar fits follow at longer or shorter intervals.

In dogs, obstruction of the bowel caused by foreign bodies is shown by vomiting and complete loss of appetite. The animals vomit all kinds of nourishment—even pure water—soon after receiving it. Severe febrile symptoms, which generally accompany inflammatory diseases of the mucous membrane of the stomach or bowel, are here wanting. Under such circumstances diagnosis can scarcely be doubtful.

By palpation of the bowel the foreign body may sometimes be felt. For this purpose the dog is placed on his hind-legs, the body grasped from above, and the viscera allowed to glide between the fingers of the two hands, by moving these with slight pressure from the under portion of the abdomen towards the vertebræ. But such manipulation often requires to be frequently repeated to discover the foreign body. Sometimes the latter is not felt on the first attempt, but may be discovered after a short interval, say an hour ; sometimes it is so far forward, and so sheltered by the ribs, as altogether to escape palpation. Examination by Röntgen rays gives immediate information as to the position and character of the foreign body, and has been successfully resorted to in dogs.

It is easy to avoid mistaking masses of fæces in the rectum, or the kidneys or abdominal tumours, for foreign bodies. The first will be recognised as long sausage-shaped cords of a softish character. A foreign body is differentiated from a kidney by its position and mobility. The greatest difficulty arises in distinguishing foreign bodies from tumours, but as these are very rare in the anterior part of the abdomen, they may almost be neglected in diagnosis.

Dogs with stoppage of the bowel generally die in eight to ten days, with symptoms of extreme weakness ; oxen with injuries to abdominal and thoracic organs after an illness of varying length. Recovery is rare, except where the foreign body perforates the abdominal wall.

Treatment usually comes too late. In oxen, repeated attempts have been made to remove sharp foreign bodies by rumenotomy. Obich cured four cases out of thirteen ; in three, abscesses formed, and in five help was too late. Meyer has operated with success. After making an incision into the rumen in the usual way, the operator inserts his arm in a forward and downward direction to discover

the reticulum, which lies towards the right, searches this carefully, and endeavours to remove the foreign body. The chief difficulty is the impossibility of certain and early diagnosis. Provided the foreign body has not injured the diaphragm and pericardium, there is little to indicate its presence. Disturbance of digestion and breathing, caused by injury to the wall of the stomach and to the diaphragm, are not sufficient to warrant operative measures, whilst, should the pericardium be already injured, operation can scarcely procure recovery, and slaughter is generally preferable. Meyer, however, states having succeeded, even after pericarditis had set in. Eppele and Seloz removed a piece of probang and gloves from a cow's stomach by rumenotomy (see that heading).

For hair, or binder-twine balls in sucking calves, Brown (Inver-gordon, N.B.), performs laparo-gastrotomy, operating through the abdominal floor immediately behind the sternal cartilage. The calf is secured on a table, the skin is shaved, washed, and disinfected and chloroform is administered. Immediately behind the ensiform cartilage and in the middle line, an incision is made through the skin and muscle and carried backwards for about six inches. A piece of calico, soaked in an antiseptic solution and provided with an oblong opening in the centre, is laid over the wound, and the peritoneum is then incised; a hand is introduced and the abomasum, which is readily distinguished by its colour from intestine, is drawn into the wound and opened by a three-inch incision. If the stomach contains much milk it is emptied by means of a syringe; then a finger is inserted to remove the hair-ball, which is found usually near the pylorus. The wound of the abomasum is closed by Lembert's sutures of silk; the abdomen is flushed with warm saline solution, and finally the external wound is sutured, and protected with antiseptic powder, cotton wool and a bandage.

Dogs are sometimes seen to swallow the foreign body, and in such case an emetic should first be tried, but not before giving a considerable quantity of firm food (flesh), so as to distend the stomach. Faecal stasis, if already existent, may be overcome, and the foreign body brought away, by injecting warm water into the rectum. Plenty of fluid should be used, so as to distend the bowel and open the way for the foreign body. Sometimes the hypodermic injection of eserine produces powerful peristaltic action and passage of the offending object, but purgatives given *per os* are useless and are nearly always vomited.

As a last resource, laparotomy may be tried, though often it comes too late, the animal's strength being much reduced before

operation is sanctioned. Siedamgrotzky, however, was successful with a dog which had swallowed a large flint stone. Adam removed a grape shot from the stomach by gastrotomy, and effected a cure. The strictest antiseptis is, however, necessary. After narcotising

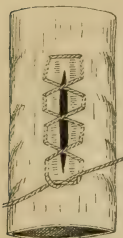


FIG. 403.
Gely's bowel suture.

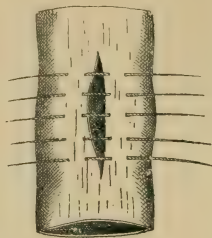


FIG. 404.
Lembert's bowel suture.

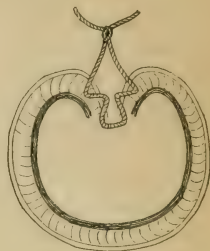


FIG. 405.
Wölfler's bowel suture.

the dog with morphine, followed by æther, or throughout with chloroform, the lower surface of the abdomen between the umbilicus and sheath or umbilicus and pubis is shaved and disinfected. The skin is then cut through close to the linea alba, and the muscular tissue divided for a distance of 2 to 3 inches. The peritoneum is next punctured, a finger introduced into the cavity to prevent injury to the bowel, and the peritoneum finally divided to the same extent

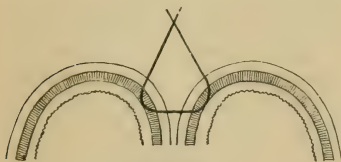


FIG. 406.
Lembert's suture.

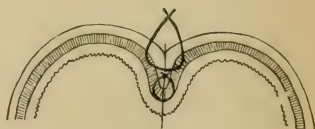


FIG. 407.
Czerny's suture.

as the abdominal wall. Two or three fingers are now introduced into the peritoneal cavity, and the foreign body sought. To prevent prolapse of the bowel, the left hand, or, preferably, a cloth saturated with disinfecting fluid, is laid on the wound. Frick passes one or more silk sutures through the entire thickness of each lip of the wound (including the skin, muscles, and peritoneum), and uses these sutures to hold apart or to approximate the edges.

It often takes some time to discover the obstructed piece of bowel, and one must not lose patience. As soon as the part is felt, it should,

if possible, be drawn through the abdominal wound. The portion of bowel coming from the stomach is immediately recognised by its being distended, and should be kept closed by an assistant compressing it. The bowel is now incised in its long axis immediately over the foreign body, which is then removed. At this stage it is important to keep the distended portion of bowel closed to prevent advancing ingesta soiling the wound, and, in case of need, a clamp may be applied, but not so tight as to bruise the bowel. It can be replaced by a twisted strip of sterilised gauze applied with moderate tension around both the afferent and efferent portions of bowel. Finally the intestinal wound is closed with bowel sutures (Figs. 403 to 407). As it is very important to bring the serosa of both sides into contact, and to make the closure as perfect as possible without piercing the mucous coat, which would perhaps lead to peritonitis, one of the methods recommended by Gely, Lambert, or Wölfler should be employed. Thereafter the surface of the intestine and of the wound is once more cleansed, the abdominal muscles and skin are sutured with sterilised material, and a proper dressing applied. Where the animal is particularly valuable continuous watching may be necessary to prevent the dressing moving or being torn off. A dog operated on by Möller, pulled off the dressing and loosened the sutures, occasioning prolapse of the bowel and death.

In the horse laparotomy has often been successfully performed for the castration of cryptorchids, and McQueen, in a paper on "Abdominal Surgery" read before the National Veterinary Association in 1895, gives a series of cases in which accidental wounds penetrating the peritoneal cavity, with or without prolapse of abdominal organs, have been successfully treated. He himself surgically opened the peritoneal cavity in four experimental cases. In three he withdrew and handled portions of intestine, incised the floating colon, and closed the wound with sutures. In the fourth he divided and afterwards united the jejeunum. The first case died of septic pneumonia; the two succeeding cases recovered, but for research purposes were afterwards killed. The last case died in 39 hours.

In practice, Dollar, Rickards, and Rogers unsuccessfully resected a portion of floating colon. Smith and Garry have also performed laparo-enterotomy for obstructed bowel, but the horses died. Félizet in 1849 is said to have cured a miller's horse in France by removing a calculus through a flank incision, but no such achievement has been reported in England. Where operation has been attempted it has usually been postponed until too late.

Should the portion of bowel surrounding the foreign body be

necrotic or acutely inflamed, it may be resected, care being taken to operate in sound tissue. A triangular piece of mesentery having the bowel for its base is at the same time removed. The ends of the bowel are then turned inwards and the opposed serous surfaces united by means of numerous fine silk sutures. McQueen used cambric needles and fine sterilised silk. The best form of suture is probably Lembert's. A second series of sutures is then inserted to strengthen the union by extending the surface of contact of the serous coats. As shown by Dollar's experiments, adhesion of the serous surfaces is remarkably rapid. To shorten and simplify the process of uniting the serous coats Murphy introduced a "button" in two parts, one of which was inserted in each end of the bowel and secured by passing a tobacco purse stitch around the periphery of the bowel. When pressed together the two extremities of the button automatically engaged and kept the two serous surfaces of the bowel firmly in contact. In four to five days the button became loosened in consequence of those portions of bowel included within it undergoing necrosis, leaving a circular line of union around the bowel. The button was passed per rectum.

Murphy's button has often been successfully used in dogs; Murphy himself made more than 600 experiments, but McQueen's experiments on horses failed, and in these animals the method cannot be recommended. Decalcified bone tubes might be useful in the larger animals.

II.—PUNCTURE OF THE BOWEL IN HORSES (ENTEROCENTESIS).

IN horses, colic is often accompanied by active production of gas in the large colon and cæcum, by which the diaphragm is pressed forward and respiration impeded, the lungs being compressed and the posterior ribs fixed. Suffocation may even be threatened, and circulation in the abdominal viscera so affected as to endanger life. The animal's recovery, therefore, depends on speedy removal of the gas. The more marked the respiratory disturbance, the shallower and more frequent the breathing, the greater is the danger. In extreme cases the animals become unsteady on their legs, stagger, fall down and die in a few minutes. Crib biting or wind sucking induces the same symptoms, though in a minor degree, and seldom leads to death, but tympanitic colic, produced by fermentation in the intestinal canal, often takes a fatal course, the reason being that in the one case air ceases to be swallowed as soon as the animal experiences discomfort or pain, whilst in the other fermentative

changes with production of gas still continue, even under considerable pressure.

Internal medicaments, supposed to neutralise or absorb intestinal gases, act too slowly, and, like those given to prevent fermentation, enter the colon too late to be of benefit. As the natural passage

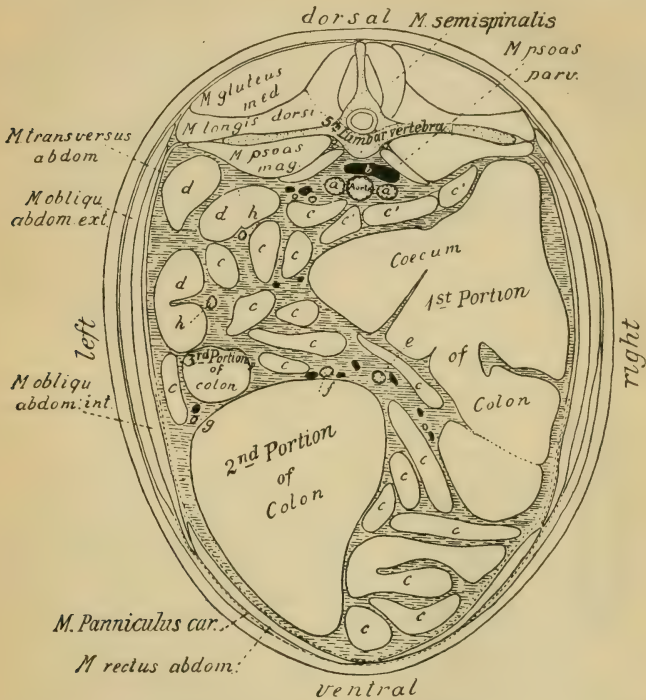


FIG. 408.—Vertical section of the horse's body between the last rib and external angle of the ilium.

a, Femoral artery; *b*, posterior vena cava; *c* and *c'*, loops of small intestine; *d*, rectum; *e*, colic artery; *f*, inferior colic artery; *g*, superior colic artery; *h*, arteries of the rectum; *i*, ureter. (After Ellenberger and Baum.)

for discharge of gas may be filled with ingesta, the only method of averting rupture or suffocation consists in providing an outlet for the gas by trocar and cannula.

The operation acts like puncture of the rumen; but puncture of the bowel in the horse is perhaps more dangerous, though recent cases show that risk of peritonitis has been greatly overestimated.

The precise cause of the greater vulnerability of the peritoneum in horses is still unknown, though it is clear that peritonitis is only caused by infective materials introduced through a wound, or derived from the intestine. The operator must endeavour to prevent such infection; but though it is easy to guard against soiling from without, it is impossible to prevent it from within, *i.e.*, from the bowel itself at the moment of withdrawal of the cannula. To minimise risk, the instrument must be of small calibre, as small, indeed, as will allow of free escape of gas. The trocar should be 9 or 10 inches long, and not more than $\frac{1}{8}$ inch in diameter. Friedberger's model has met with wide approval (Fig. 409). Cannulæ with side openings are to be avoided on account of their favouring infection of the peritoneum.



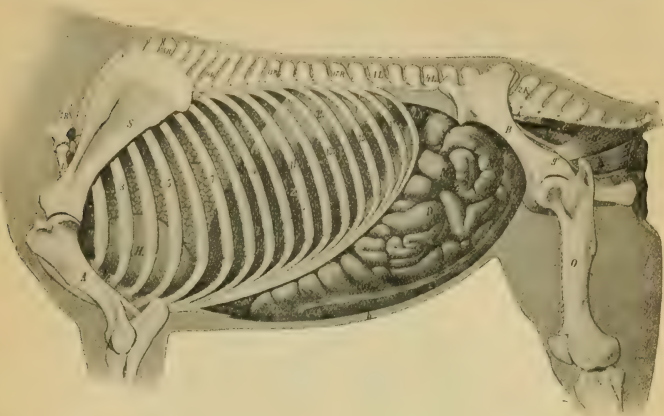
FIG. 409.
Friedberger's intestinal trocar
for horses.

The seat of operation is in the right flank, over the arch of the cæcum and fourth portion of the double colon, which in tympanites are closely applied to the abdominal wall. The lower portions of the colon usually contain masses of ingesta, while the gases collect in the upper parts, whence their discharge by means of the cannula is both easier and less dangerous. The field of operation, which is fairly extensive, is bounded above by the transverse processes of the lumbar vertebræ, in front by the posterior edge of the last rib, behind by the angle of the haunch, and below by a line drawn from the middle of the last rib. The point to select is that which projects most prominently and returns a tympanitic sound on percussion, but should these signs for any reason be wanting, or appear more distinctly at another spot, the latter may be selected without disadvantage.

The trocar and cannula should be boiled for five to ten minutes in soda solution, the hair clipped or shaved off, the skin washed with soap and rinsed with a disinfectant such as iodine, or sublimate solution.

The trocar is then thrust through the abdominal wall at the point indicated. To render its passage easier, an incision may first be made through the skin with a bistoury, though this is seldom necessary. In passing the instrument it is steadily pushed downwards and inwards or slightly towards the left side of the horse. As a rule, the trocar can be introduced for 4 to 6 inches, or even to the flange of the cannula without danger. The stilette being with-

drawn, the gas discharges with a hissing noise through the cannula, which is held in position until the distension subsides or gas no longer



[FIG. 410.—Showing the relative positions of the thoracic and abdominal organs. Left side. (After Leisering.)

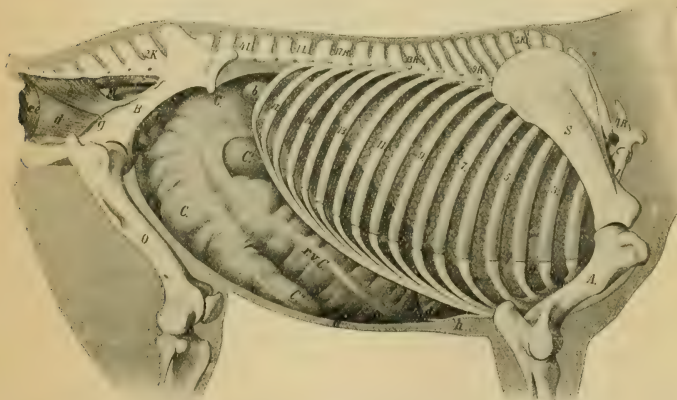


FIG. 411.—Showing the relative positions of the thoracic and abdominal organs. Right side. (After Leisering.)

escapes. Sometimes very little gas escapes, or its discharge may suddenly be arrested ; this may be due to the puncture having been

made at the wrong place, to the gut slipping off the cannula, to blockage by ingesta, or to movement (or peristalsis) producing a kink in the bowel. The difficulty may be overcome by inserting the stilette and moving the instrument from side to side; if not, trocar and cannula should be withdrawn and reinserted two or three inches

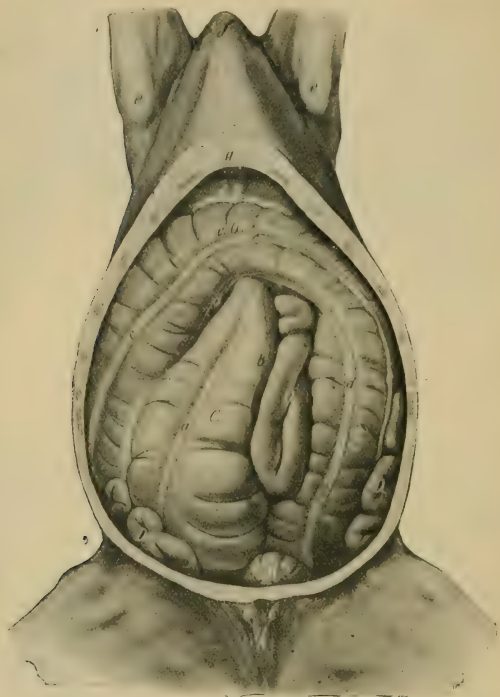


FIG. 412.—Abdominal organs seen from below.

C, Cæcum; *r. v. C*, 1st portion of colon; *v. Q*, suprasternal flexure; *l. v. C*, 2nd portion of colon; *d. Q*, diaphragmatic flexure; *D*, loops of small intestine; *M*, loops of floating colon.

lower, and if gas should not be obtained, further punctures may be made at points in the lower part of the right flank or behind the last rib. Occasionally owing to failure to afford relief by puncture in the right side, the operation is repeated in the lower region of the left flank. While in marked distension there is no particular objection to operation on the left side, the danger of the trocar transpiercing

the small intestine should not be overlooked, and, as Cadiot suggests, puncture through the left flank should be reserved for special cases. Frequently horses have been punctured in three and four places in the right flank without any sort of adverse result. As long as the cannula remains in position, the animal must be watched to prevent the instrument becoming displaced. To prevent infective material escaping into the peritoneal cavity when withdrawing the cannula, some antiseptic fluid should be injected through it into the bowel, and the stilette should be reinserted before the cannula is removed.

The wound is now cleansed, disinfected, powdered with iodoform and covered with adhesive plaster or collodion. Both the skin and intestinal wounds generally close by first intention, if antisepsis has been carefully carried out.

To prevent the bowel falling away from the cannula and the entrance of intestinal contents into the peritoneal sac, Brogniez constructed the enterotome, which consists of a trocar, whose cannula is provided with projections capable of being opened by pressure after insertion. As Brogniez's enterotome is of great diameter and its surfaces are not smooth like those of the trocar, the instrument is not only inefficient, but positively dangerous, on account of its favouring the passage of intestinal contents into the peritoneal cavity and increasing the risk of peritonitis. In some cases the wings of the trocar have refused to collapse, and removal of the instrument from the peritoneal cavity has been attended with great difficulty.

The method proposed by Bourgelat, Chabert and others, and revived by Föhringer and Imminger, of puncturing the bowel from the rectum, is attended with the risk of infecting the peritoneum from the mucous membrane of the bowel, a danger which cannot be entirely overcome, even by careful antisepsis.

In the case described by Imminger, rotation of the colon on its long axis possibly existed, and after discharge of the gas, underwent spontaneous reduction. In such cases, reposition should certainly be first attempted, and only when this fails does puncture of the colon appear indicated, though even then the abdominal wall should be preferred to the rectum, especially as the position of the colon can generally be discovered by rectal exploration.

If for any reason puncture through the rectum be considered unavoidable, the bowel should as far as possible be emptied, and most carefully rinsed out with sublimate solution, as recommended by Imminger. The left hand is then passed into the rectum, whilst the right introduces the trocar (with the stilette drawn back), and, guided, by the left hand, places the instrument against the pelvic flexure of the colon, which will be found distended with gas. The stilette is then thrust forward with a slight jerk, and the trocar caused to enter the colon. For this operation a curved trocar is indispensable. The one used by Imminger has a length of nearly 9 inches, and a diameter of $\frac{1}{8}$ of an inch, and corresponds to Flourant's instrument, except in being somewhat thinner. Further procedure is similar to that in puncturing through the abdominal wall.

Very rarely pus forms at the point of operation, by which the danger of peritonitis is increased and recovery delayed, though not necessarily prevented. In cases seen by Rainard and Schaak, pus burrowed as far as the scrotum. Brogniez lost a case after puncture, owing to injury of, and fatal bleeding from, a cæcal artery.

Even at the present day the best authorities hold very conflicting views as to the value of puncture of the bowel; and as operation does not remove the primary diseased condition, it must always fail in some cases. In the Lyons clinique the results were bad, but that this was not the fault of the operation is shown by the fact that twenty-five horses experimentally operated on were little the worse.

III.—PUNCTURE OF THE RUMEN AND RUMENOTOMY.

IN sheep and oxen gas often increases rapidly in the rumen, distends the abdomen, and presses so strongly on the diaphragm as to interfere with respiration and endanger the animal's life. This is generally due to rapid consumption of large quantities of fermentescible materials. Red clover, eaten whilst covered with dew, or in a withered or heated condition, and rapidly grown juicy green food, particularly that grown on heavy ground, are especially dangerous. But any other food which easily ferments, like brewer's grains, wet bran, and roots, &c., may lead to rapid development of gas and distension of the stomach. A frequent cause of tympanites is the presence of foreign bodies in the œsophagus, which prevent the regular discharge of gases formed in the rumen.

Reiset's experiments on oxen, rendered tympanitic by feeding on clover, show that these gases consist of 74 per cent. of carbonic acid, 24 per cent. of carburetted hydrogen, and 2 per cent. of nitrogen; in wethers of 76 per cent. of carbonic acid gas. Lungwitz's analysis gave 80 per cent. carbonic acid, a certain quantity of marsh gas, nitrogen, oxygen, and traces of sulphuretted hydrogen. Lungwitz thinks that the composition of the gas depends not only on the nature of the food, but also on the stage which digestion has attained. At first more carbonic acid gas is found. The small quantity of gas found in the stomachs of hungry animals consists principally of marsh gas with some nitrogen and oxygen, but contains little carbonic acid.

The symptoms of acute tympanites are unmistakable, the most striking being more or less rapidly developed swelling, particularly in the left flank, which, under certain circumstances, rises above the level of the lumbar vertebræ. The abdominal walls are often distended to the utmost, and on percussion give forth a hollow sound, feeding ceases, the animals are restless, show colic, and dyspnœa

keeps pace with the advancing distension; the respirations become shallow, the countenance is anxious, the veins about the head, neck, and abdomen (milk vein) are greatly distended, the pulse grows more frequent and smaller, the action of the heart tumultuous, and, after staggering movements, the animal falls to the ground and dies from suffocation.

The course of the disease is acute; death may occur within an hour; sometimes the attack continues for twelve to twenty-four hours, seldom longer. The more rapid the rate of distension, the greater the danger. The condition is particularly grave where the right flank also appears distended. Slight cases may recover of themselves, but severe ones are always fatal if speedy relief be not



FIG. 413.—Mouth gag for oxen.

afforded. Large numbers of animals when under similar conditions may simultaneously become affected.

Treatment. Internal remedies, such as lime water, liquor ammoniæ, oil of turpentine, petroleum, potassium chlorate, hyposulphite of soda, &c., have been recommended to assist absorption of gas and to prevent its further development. Lungwitz, on the basis of his laboratory researches, recommends 4 per cent. magnesium oxide suspended in water, milk of lime, and 2 per cent. of spirit of ammonia, or, in emergencies, soapy water. These agents are seldom of much service and are only used in semi-acute tympanites.

Fastening a piece of plaited straw smeared with tar in the mouth, inserting the mouth gag (Fig 413), or drawing the tongue strongly forward, is said to assist eructation, and the use of the probang has been recommended as giving immediate relief.

Strong pressure on the left flank may be effective. The gases are directly discharged and movements of the paunch at the same time excited.

Though such measures may prove sufficient in slight cases, time should not be lost in making trial of them in severe attacks; and as soon as dyspnœa is marked, the probang or trocar ought at once to be employed.

The probang for cattle consists of a spiral of steel provided with a coating of leather (Fig. 342), though the simple steel spiral is sometimes used. In sheep the vesical catheter used for horses forms a sufficiently effective probang. As the patient should not be cast, passing the probang in an excited animal suffering from severe dyspnœa is often not easy, but cattle are usually better subjects than sheep.

To ensure the instrument taking the right direction, a piece of wood provided with an opening (mouth gag) is first inserted in the mouth, and through this the tube is passed. The animal's head is then extended and the rounded end of the well-oiled probang pushed along the palate into the pharynx, whence it glides into the œsophagus. Care is required to prevent it passing into the larynx and trachea, an accident which is announced by violent coughing; in such case the tube must immediately be withdrawn. Should it have safely gained the œsophagus, it passes easily downwards without any untoward symptom, and can be felt on the left side of the neck. As soon as the end reaches the stomach the stilette is removed and the gas allowed to escape through the hollow tube. But this does not always follow; sometimes the tube becomes stopped with ingesta and the stilette must again be introduced; often the gas is mixed up with the fermenting food, and this explains why even the probang has not always the desired effect.

Puncture of the rumen forms another means of treatment, the rumen being pierced in the left flank with the trocar. The operation is very simple, and is often carried out by laymen when danger of



FIG. 414.—Trocar and cannula for puncture of the rumen.

suffocation threatens. In the case of cows and sheep even a pocket knife can be used, should a trocar not be at hand. Round trocars without side openings are almost exclusively used; the largest, having a diameter of half an inch, is used for oxen, and a somewhat smaller one for sheep.

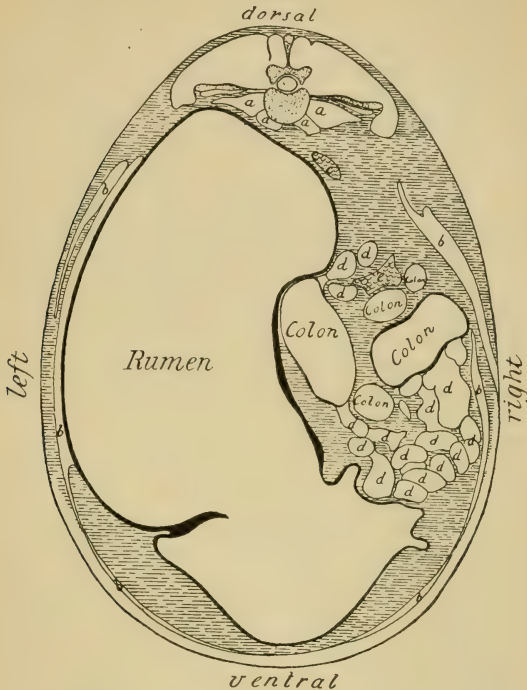


FIG. 415.—Vertical section of the ox's body, showing relative position of rumen and other organs.

a, Lumbar muscles; *b*, abdominal muscles; *c*, glands; *e*, portion of the pancreas. (After Ellenberger and Baum.)

The seat of operation is the centre of the left flank, which becomes very prominent in the tympanitic animal. In fixing the spot, one imagines a line drawn forwards through the angle of the haunch parallel with the vertebræ. In cattle the trocar is inserted on this line about 4 to 6 inches, and in sheep about 2 to 2½ inches, in front of the angle of the haunch. As delay is often dangerous, there may

be no time for cleansing the point of operation, otherwise the usual precautions are taken. Where the skin is thick, it is best to make the primary incision with a bistoury; older practitioners were in the habit of using the fleam for this purpose. The trocar is now thrust through the walls of the abdomen and rumen, being directed slightly towards the right. Considerable force is required, and a slight rotary movement should be made. If the operator is of slight stature, it may sometimes be easier to give a smart blow on the instrument with the open hand. On account of the size and distension of the rumen, it is of no importance how far one thrusts the trocar; no injury is likely to result, and therefore it may be allowed to enter up to its shield.

When the stilette is removed the gas rushes out, sometimes under high pressure and mixed with particles of food, which are apt to block the cannula, and require to be removed with the stilette or a probe.

The cannula is tied in position until fermentation ceases. To make sure of this the cannula may be closed with a cork and the animal watched; if tympanites fail to recur, the instrument can be removed. Before doing so, however, a few ounces of an unirritating antiseptic may be injected; the stilette is then reintroduced, the skin is held in position with the fingers of the left hand and the whole instrument slowly withdrawn.

The skin wound requires no particular treatment, though it may be cleansed and covered either with a pitch plaster, or collodion. Bad results seldom follow the use of the trocar in oxen, though digestion may sometimes be impaired by prolonged distension or by the rumen becoming adherent to the abdominal wall.

The operation is more dangerous in sheep, though it becomes necessary in cases of threatened suffocation. If possible, the long wool should first be clipped away. Where the rumen is punctured with a knife, a thin tube, or an elderberry stem, may be used as a cannula, being introduced into the rumen alongside the blade. The animal must be watched during the whole time the tube remains in position to prevent its being displaced.

Rumenotomy. In dealing with a rumen distended with a mass of fermenting food containing much gas, when the trocar is no longer of value, rumenotomy, which cattle tolerate very well, can alone give relief.

The animal is placed with the right side against a wall and fastened up short. To prevent sudden movement or kicking, the hind-limbs may be tied together above the hocks, or a pole held in a sloping direction may be placed in front of the left hind-leg.

The hair over the left flank is now clipped, the skin cleansed, and a strong knife, with its back towards the spine, introduced at the point where the rumen is usually punctured (Hertwig's method). With a drawing movement, the wound is now extended downwards, in oxen for a distance of 4 to 6 inches, in sheep $1\frac{1}{2}$ to 4 inches. To prevent food entering the peritoneal sac, it is necessary to avoid making the skin wound smaller than that in the wall of the rumen.

The operation may also be carried out by first cutting through the skin at the point indicated, dividing the abdominal muscles, and finally incising the peritoneum and wall of the rumen.

Immediately the rumen is opened gas and fermenting food often rush out with considerable force. To maintain the opening in the rumen in contact with that in the abdominal wall and to prevent food entering the peritoneal cavity, tape sutures are inserted through both rumen and abdominal wall—one on each side and one in the lower angle of the wound; and as a further precaution against soiling the peritoneum a piece of mackintosh cloth may be placed over the edges at the lower angle of the incision. The tapes are introduced from within outwards, and each carries at its end a tuft of tow, which acts like a knot; the free ends being drawn, open the wound and hold the rumen in position. Employing the hand or a scoop, two-thirds of the contents of the paunch should be removed.

The rumen having been partially emptied, stimulants or antiseptics may be poured into the stomach; then the wound of the rumen is carefully cleansed and closed with silk or catgut, Lembert's sutures being used. These are so placed that no food material can pass between them, and it is very important that the edges of the wound be inverted with the peritoneal surfaces in close apposition. The opening in the abdominal muscles is closed with a continuous suture of strong silk, and that in the skin may be left patent without serious disadvantage. If, however, healing by first intention is desired, the cutaneous wound should also be closed, preferably with quilled-sutures, and afterwards protected with a pitch plaster. Sometimes the wound heals in a few days, but may take weeks and even months, or leave behind a fistula of the rumen.

Obich recommends suturing the wall of the rumen to that of the abdomen, and leaving the stitches in for seven or eight days. Meyer is opposed to this, and states that it causes tearing. Extensive adhesion of the rumen to the wall of the abdomen certainly interferes with digestion.

To prevent food infecting the peritoneal cavity, Sajoux as early as 1839 employed a trocar with movable wings by which to fix the rumen to the abdominal wall (Hering); about the same period three instruments termed "gastrotomes" were constructed by Brogniez.

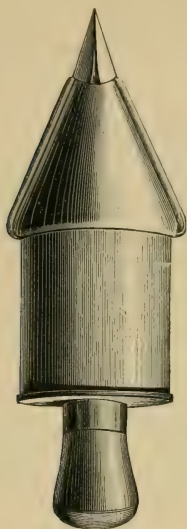


FIG. 416.—Bräuer's trocar.



FIG. 417.—Forceps for use with Bräuer's trocar.

In Germany this complicated piece of apparatus was never much used, because it by no means absolutely prevents infection of the peritoneal cavity; on the contrary, as it requires great care and cleanliness to keep it in perfect condition, it is frequently unavailable when most wanted.

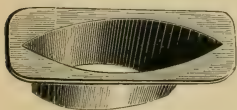


FIG. 418.

Sheath of Bräuer's trocar.

The trocar constructed by Bräuer (Fig. 416) appears simpler and more practical. Its cannula is so wide that the food may be removed through it from the rumen by using a pair of forceps. The handle and the greater part of the stilette consist of wood; the latter is flattened, and ends in a cutting part, which is formed by the union of two knife-shaped portions of steel, which come together in a point. The cannula is of tinned iron, and has at its upper part an opening $4\frac{1}{2}$ inches long in one direction and $1\frac{1}{2}$ inches in the other; below, the aperture measures 4 inches in the one, and $1\frac{3}{8}$ in the other direction (Fig. 418). The hair is cut from the seat of operation, the skin cleansed, and the instrument applied like a trocar, but as it

requires considerable force to thrust it into the rumen, a moderately heavy hammer or mallet is employed.

After removing about a third of the contents of the rumen with a pair of spoon-shaped forceps, whose blades are $\frac{1}{4}$ inch (6 mm.) broad, and 16 inches long, Bräuer attaches a funnel to the cannula, and pours in 10 to 15 quarts of salt water.

Treatment of the wound, in rumenotomy and after the use of Bräuer's instrument, is conducted on general principles.

As this operation is most frequently performed in summer, when flies are common, it is best to apply a dressing which guards against insects and soiling by the tail or mouth. Smearing the parts with tar serves a similar purpose. To prevent relapse some care is required in feeding after operation. For further information on this point, handbooks on special pathology should be consulted.

Hayne, in 1836, recommended "punctio ventriculi" in the horse to remove gases from the stomach. Apart from the fact that diagnosis is very difficult in these cases, gastric tympanites very seldom occurs in the horse, and generally only as a consequence of stasis in the small intestine, in which case the operation cannot be very beneficial. Passing a tube into the stomach *via* the mouth and gullet is more effectual and far less dangerous than gastric puncture in the horse.

IV.—INTUSSUSCEPTION OR INVAGINATION OF THE BOWEL.

IN oxen invagination of the bowel forms one of the most frequent causes of fatal colic. In horses and dogs it is of rarer occurrence. While operation for this condition has not hitherto been attempted in horses, it has been performed with considerable success in oxen and dogs. Excessive and irregular peristalsis may cause several feet of the small intestine to become intussuscepted. The outer (invaginating) portion strangulates the inner (invaginated) and disturbs circulation; the onward movement of ingesta is stopped, and, broadly viewed, the same conditions obtain as in strangulated hernia. Oxen may survive for five to ten days, or even longer, but horses die rapidly. In exceptional cases the invaginated portion is said to become necrotic, to pass forward through the invaginating piece and be discharged with the fæces. Invagination is commonest in the rectum or small intestine, but in the horse Merten, Hübner, and others have observed passage of the cæcum into the colon.

Symptoms. The disease begins with a severe attack of colic, which may last twelve hours, and is followed by subsidence of pain, though appetite is wanting. Rumination ceases, tympanites and discharge of blood-stained mucus set in, or obstinate constipation occurs; the pulse becomes frequent and small, but the temperature

seldom rises. On examination per rectum, the invaginated spot may sometimes be felt as a cord-like, painful swelling. Slight colicky symptoms, straining to pass fæces, and discharge of small quantities of mucus or blood continually recur. Merten says the animals show a desire to lie on the back.

Dogs show no sign of colic. They move about restlessly and usually lie down flat on the belly. Appetite completely disappears, but water is often taken greedily. Water, food, and medicine are, however, usually vomited at once. The vomit is bile-stained. No fæces are passed, though there may be straining. Local examination (palpation) of the abdomen reveals the invagination as a sausage-shaped, painful swelling.

Diagnosis is often difficult; in oxen and dogs it may be necessary to perform an exploratory laparotomy under antiseptic precautions.

Treatment. Medical treatment is worthless, and purgatives cannot, of course, reduce the invagination.

Siebert attempted reduction by generating carbonic acid gas in the body. After giving aloes with sulphate of soda in linseed tea, he injected 25 ounces of bicarbonate of soda suspended in water into the rectum, which had previously been emptied as far as possible, with the hand and clysters. Diluted hydrochloric acid was then passed in, and the anus closed with the hand. In a short time the right, and later the left, side became greatly distended, and the animal strained so much that it was difficult to keep the anus closed. After a time the hand was removed, a large quantity of carbonic acid gas and fæces escaped, and the animal recovered. Siebert states having thus cured a cow of invagination of five days' standing; but his treatment is scarcely recommended by the fact that he afterwards found the cast-off portion of bowel in the dung. If invagination had really existed, recovery was due less to the treatment than to the *vis medicatrix naturæ*. The method may, however, be tried when operation is out of the question and other means are ineffectual.

Surgical treatment consists in opening the peritoneal cavity from the right side with antiseptic precautions, and reducing the invagination or resecting the affected piece of bowel. The animal is placed with the left side against a partition and is secured with cords and planks. The hand is introduced into the abdomen, the diseased spot discovered, drawn forward, and an attempt first made to reduce the invagination, but this may fail because the opposed surfaces of serosa have become firmly adherent. Degive's experience shows, however, that when the union is not intimate there need be no hesitation in effecting reduction. The abdominal wound should then be closed with the usual precautions.

Reduction failing, resection becomes the only alternative, and has been performed by Meyer with success in oxen. In his "Manuel

opérateur pour l'espèce bovine," Guittard describes it as quite an everyday affair. Bleeding, after cutting through the bowel or mesentery, can be stopped by torsion, or the vessels may be ligatured with sterilised material. Great difficulty is caused by the continual passage of ingesta through the anterior section of bowel, which accordingly should be compressed by a bowel clamp, or lightly ligatured during operation. After removing the invaginated portion, the ends of the bowel are brought together by the bowel stitch, the wound of the abdominal walls is sutured and antiseptically treated.

Taccoen operated on two cows, from one of which he removed 10 inches of bowel, but had no bad consequences. Thirty-five days later the external wound was healed, and, on slaughter, the incision in the bowel was found to be completely cicatrised. In a second case, an incurable anus preternaturalis formed, but did not impair the animal's health.

Riedinger treated, during 1890, ten cases of invagination of the bowel in oxen. Seven animals had to be slaughtered on account of the operation being done too late; in the others laparotomy was carried out and the invagination reduced. The portion of the bowel was cleansed with 1 per cent. of sublimate solution, replaced, and the wound closed with button sutures. After-treatment consisted in giving purgatives. Five to six hours after operation, action of the bowels occurred. In one of the animals peritonitis occurred five days after operation, rendering slaughter necessary; the two others recovered in fourteen days.

In dogs laparotomy can be performed through the abdominal floor and the invagination reduced or the bowel resected as above described. In the latter case Murphy's button can be used.

V.—TWIST OR ROTATION OF THE COLON IN HORSES.

IN 1890, Jelkmann first indicated the possibility of recognising during life and of surgically treating torsion of the colon, which not infrequently occurs in horses, and often leads to death. The importance of this question is shown by the constant occurrence of the disease. According to Jelkmann, 70 out of every 192 horses dying of colic in Munich had twist or displacement of the colon. Of 23 post-mortems after colic, made in the year 1887-8, twist of the colon was found in 10. According to the statistics given by the Veterinary Sanitary Reports of the Prussian army, in 1889, as many as 84 horses died from displacement or twist of the colon. Great credit must be given to Jelkmann for having directed attention to this point, and, though his statements have in certain quarters been met with distrust, this may be explained in part by the fact that practitioners had not made themselves sufficiently acquainted with the anatomical conditions or methods of surgical treatment. In 205 colic patients Jelkmann found displacement 13 times, and effected

recovery by retroversion. During 1890, 63 cases of rotation of the colon were met with in the horses of the Prussian army, and during 1891, 52 cases.

Jelkmann says the twist is usually towards the right, and is produced by distension of the upper portion of the colon and its displacement from the left lower wall of the belly at the same time that portions of the rectum are forced towards this spot. If the animals rise after lying on the right side, the upper portion of the bowel, which has been displaced towards the middle line of the belly, is thrust downwards and finally twisted around its long axis. This explains many cases; but just the opposite sometimes occurs, and twist takes place towards the left, as is shown by the reports of post-mortem examinations in the Pathological Institute of the Berlin College. Sometimes the upper layer of the colon is displaced towards the centre line, sometimes towards the left abdominal wall. The comparatively great length of the portion of bowel filled with food, and its freedom to move, explain the frequent occurrence of rotation. (For the normal position of the abdominal contents see Figs. 410, 411 and 412.)

The symptoms are not characteristic, but a rectal examination generally removes any doubt. When colic, at first slight, is accompanied by continued pain and becomes worse hour by hour, the bowel sounds weaker, the pulse smaller and more frequent, and some form of stoppage of the bowel seems certain, a rectal examination will generally clear up the point. In front of the anus, one feels the distended colon, which may for the moment be mistaken for the over-filled urinary bladder, but careful examination reveals its real nature. The longitudinal muscular bands can be distinctly felt, and show, not only that we have to deal with the colon, but also in what direction torsion has occurred. When the bowel is in its proper position, the bands run nearly parallel with the long axis of the body; but in twists, a change in their course is distinctly appreciable. In torsion towards the right, they run backwards and inwards; in torsion towards the left, backwards and outwards. According to Jelkmann, the rectal mesentery, whose fixed border can be felt below the lumbar vertebræ, appears greatly stretched, and in right rotation does not pass perpendicularly downwards, but towards the left, and pressure on it causes the animal pain. Careful examination of the direction of the bands of the colon seems of more importance in diagnosis, and no doubt can exist either as to the presence or direction of the torsion if they can be discovered, but the posterior bands of the cæcum, which can be distinctly felt when the

latter is distended with food, must not be mistaken for those of the colon. Such an error is avoided by remembering that normally the cæcum runs from the outer angle of the right ilium in a bow directed backwards and ends near the left stifle.

Prognosis. In very exceptional cases torsion may be reduced by the animal rolling, but, as a rule, the only chance of recovery lies in early manual treatment. Though the question whether reduction is possible in every case, or how often it may be effected, cannot yet be settled for want of published observations, it is clear, from Jelkmann's communication, that it often succeeds, and Möller considers it practicable though it certainly requires considerable muscular power in the arms and ability to withstand fatigue. This would probably become less after practice.

Treatment is commenced by giving a clyster of lukewarm water in order to clear the rectum as far as possible, and to obtain sufficient room for introducing the hand. Jelkmann inserts the left hand, presses forward towards the left abdominal wall, and endeavours to thrust the left portion of the colon with the convolutions of the rectum forwards from this point towards the middle line of the abdomen. Once the bowel is brought into this position, Jelkmann passes the hand slowly upwards, when the colon falls back over it into its normal position; he considers that the convolutions of rectum, displaced towards the left lower abdominal wall, having been thrust upwards, leave room for the colon to return to its normal position. Möller's experiments tend to support this explanation.

Möller replaced a left rotation of the colon in the following way :—After emptying the rectum, the right hand was introduced, and discovered the bands of the colon running from in front backwards and outwards or towards the left. The bands of the colon lying above were now employed to bring about reposition. Whilst the hand in the rectum was strongly abducted, its volar surface or the fingers were laid against the bands, and after repeated careful attempts finally succeeded in drawing these so far towards the right that the colon again took up its position parallel with the middle line of the body. As had been shown by the experiments on dead animals, in torsion towards the left, the bands of the lower section of the bowel offer a purchase for retroversion. After effecting this, the pelvic flexure of the bowel, until then filled with gas, at once collapsed, the symptoms of colic disappeared, peristaltic action, which had almost completely ceased, again set in, the small, frequent pulse altered its character, and half an hour later the recovery of the animal could be confidently foretold.

It is clear that all torsions of the colon cannot be treated by one and the same method ; differences in displacement will render modification necessary ; but when attention has been directed to the point, experience will give valuable indications for procedure. Puncture of the over-distended colon might possibly assist reduction (see "Puncture of the Bowel"). Jelkmann was compelled to puncture the cæcum five times in thirteen cases, after which retroversion succeeded ; the use of the trocar caused no bad results.

Before attempting manipulation, Gultmann evacuates the gas by puncture. Imminger and others recommend puncture and claim to have seen reduction of the twist in consequence. Whether puncture is always necessary can only be settled by more extended observation. It is desirable that reduction should be attempted oftener than at present ; those who have tried it speak of the method in favourable terms.

Möller describes the following case :—

I was called to see a heavy cart-horse which had been suffering from colic for twenty hours. There was moderate but continued restlessness ; the animal lay down frequently, but soon rose again, moved about in various directions, and showed all the symptoms of obstruction of the bowel. The pulse was sixty-five per minute, small and weak, the mucous membranes dirty red, respirations thirty and shallow, the flank moderately distended with gas, peristalsis occasionally slightly audible at the right side, and general sweating. Defæcation had been in abeyance for twenty hours, only three hard portions of dung having been passed, the appetite had decreased during the same period, and drink was only taken in small quantities. Examination per anum discovered the pelvic flexure of the colon greatly distended with gas, which caused it to be pressed towards the posterior wall of the pelvis. On the outer surface of the colon a tense cord could be felt which passed from above downwards and inwards, from behind upwards and outwards. A similar cord passing in the same direction could be detected on the inner surface of the colon ; the urinary bladder was only partially filled.

The hand introduced into the rectum, was laid in the above described manner against the outer cord, and after several attempts it was found possible by very considerable exertion, to move the bands of the colon towards the middle line of the abdomen. Active peristalsis and passage of gas at once followed, after which firm excreta were passed. The restlessness decreased, and after a short time entirely disappeared, whilst the pulse recovered its normal condition, and the mucous membrane lost its redness. In an hour, pain was entirely gone.

Other forms of displacement of the bowel in horses have not yet been surgically treated, if we except Meschkow's case, in which the rectum was strangulated by coils of small intestine. Meschkow performed laparotomy, reduced the strangulation, and the horse recovered.

SURGICAL DISEASES OF THE POSTERIOR PORTIONS OF THE RECTUM AND OF THE ANUS.

IN large animals the posterior end of the rectum to the extent of 8 to 12 inches, and in smaller ones to a correspondingly less extent, is not covered by peritoneum, but attached to the surrounding structures by loose connective tissue. This portion lies, therefore, beyond the peritoneal cavity, and is connected above with the sacrum, and below, in males, with the bladder, in females, with the vagina.

The thin and hairless skin of the anus possesses many sebaceous and sweat glands. In carnivora a small gland, about the size of a hazel-nut, exists on either side of the anus, and is surrounded by the sphincter ani; it contains a greenish fatty fluid. In addition to sebaceous glands, carnivora possess flask-shaped anal or perineal glands.

I.—CONGENITAL MALFORMATIONS. ABSENCE OF THE ANUS AND FORMATION OF CLOACÆ (ATRESIA ANI ET RECTI, FISTULA RECTO-VAGINALIS).

DURING early intra-uterine life, the anus is formed by invagination of the outer coverings. In the horse and ox this happens during the eighth week, in sheep, goats, and swine in the seventh, and in carnivora in the fifth. In dogs and swine, less frequently in ruminants and horses, the process sometimes remains incomplete, and in consequence the new-born animal possesses no anal opening. This *vitium primæ formationis* may be confined to the anus (Fig. 419) or the posterior portion of the rectum may also be closed (atresia recti, Fig. 420); less frequently the anus appears open, but a portion of the rectum closed. The sphincter ani then develops regularly, and a depression occurs at its middle point in place of the anal opening.

In females the rectum sometimes opens into the vagina, a condition described as recto-vaginal fistula (anus vaginalis or cloaca formation); Rotter saw it in a six months pig. Less frequently a communication exists with the bladder (anus vesicalis). Varoldi saw atresia recti with cloaca formation and open urachus in a calf.

Symptoms. The want of an anal opening is seldom noticed in animals immediately after birth; as a rule, it is only discovered when the results of suppressed defæcation become well marked;

the little animal's abdomen appears distended, colic sets in, the patient stops sucking, strains and attempts to pass fæces, and when the



FIG. 419.—Congenital malformation—atresia ani in the bitch (semi-diagrammatic).

anus is examined it is found there is no opening. If the anus alone is imperforate, the skin projects at the centre of the sphincter, rectal contents may even be distinctly felt beneath it ; but, when the walls



FIG. 420.—Congenital malformation—atresia ani et recti in the bitch (semi-diagrammatic).

of the rectum are also adherent this projection is wanting, and either the anus is visibly closed or, on introducing the finger or a probe, an obstruction is felt not far from the external orifice. In recto-vaginal fistula excrement escapes by the vagina, and the com-

munication between the upper vaginal wall and rectum can usually be discovered with the finger or probe.

In the latter case the animal may live, provided the ano-vaginal opening is large enough to allow discharge of bowel contents. Burmeister saw an ano-vaginal fistula of the size of a straw in a six weeks pig. Pieperbrok found recto-vaginal fistula and imperforate anus in a pregnant sow.

In atresia ani or recti the animals sooner or later die, if provision be not made by operation for discharge of excrement, though, as the milk forms comparatively little fæces, the animals may continue to live for several weeks. Atresia ani was seen by Waltrup in a twenty-six days sucking pig, and by Möller in a puppy of the same age. Ruminants seldom live so long; in them severe disturbance results from suppressed defæcation after four to eight days; in a case described by Bull, a calf lived five days: the post-mortem showed the walls of the rectum adherent for a distance of 5 to 6 inches.

Prognosis is in general favourable, provided operation is not too long deferred. It depends principally on whether the anus alone or both anus and a considerable length of rectum are simultaneously closed; in the latter case there is always great difficulty in laying open the bowel and in keeping it patent. The artificial anus tends strongly to contract and interfere with defæcation, whilst the rectum becomes paralysed on account of severe distension, and may even be ruptured; in such case operation gives no relief.

Treatment. Operation is the sole resource. Some recommend delaying it for a day or two after birth, because moderate distension of the rectum is rather advantageous, but as a rule the surgeon's attention is not demanded at this time, often not till much later, when death is unavoidable. In atresia ani the anus is only closed by a layer of skin which is simply grasped with forceps and cut through with the scissors. Fæces are usually discharged at once; if not, the subcutaneous tissue, which sometimes contributes to the obstruction, must be thrust on one side. Reunion of the edges may generally be prevented by smearing the parts with some mild ointment. For a similar purpose the mucous membrane of the rectum is in man united with the outer skin by incising the skin from above downwards right over the anus, dividing the subcutis on either side of the projecting end of the rectum, cutting through the mucous membrane in the same direction, and uniting it with the outer skin by several interrupted sutures. Stenosis is thus prevented.

The operation for atresia recti is more difficult, particularly if the rectum is extensively adherent to neighbouring parts. The less

prominent the anus from pressure of bowel contents, the more unfavourable the condition. In such cases the adhesions must be broken down, taking care in males to protect the urethra and bladder, and in females the vagina. In males a catheter should be introduced into the urethra, in females the index finger of the left hand inserted in the vagina during operation. The first incision is then made, as above described, by either removing a piece of skin with scissors, or making a cross-shaped cut through the skin over the anus, and gradually thrusting a finger or probe into the depths until the lumen of the rectum is attained. The position of the probe or finger indicates the proper direction.

In animals the trocar has been recommended for opening the occluded rectum, but the above method deserves preference. After discharge of fæces, an attempt should be made to suture the mucous membrane to the skin, and recurrence may be prevented by frequently smearing the parts with oil. Clysters assist the bowels in acting for the first few days.

Howard produced a colic fistula in a sucking pig with atresia recti. The same operation has been practised in man, but being as a rule of no practical value, is now seldom adopted. Treatment of recto-vaginal fistula is described later.

II.—INJURIES TO THE RECTUM AND ANAL REGION.

INJURIES to the rectum in mares and cows may be caused by the penis during the act of coition, while perforations result from incautious exploration of the rectum with the hand, and by the attempts sometimes made by laymen to remove blood from the mucous membrane of the rectum in order to cure colic. The incautious use of clyster syringes may produce wounds; and injuries are occasionally inflicted on the rectum by persons desiring to revenge themselves on the owner of the animal.

Less frequently the rectum is ruptured by abnormally large and hard masses of fæces, but in mares and cows during parturition, injuries caused by the fœtus, or by violent and awkward attempts at assistance are common, the colt's feet sometimes penetrate the upper wall of the vagina or uterus, and the lower wall of the rectum.

Finally, any hard substance accidentally swallowed with the food may penetrate the mucous membrane of the rectum or anus and produce proctitis. In dogs, animal or fish bones are a frequent cause. In a horse which had swallowed a large number of fir-needles, Kirchner found inflammation of the rectum caused by the needles

penetrating the mucous membrane. Stockfleth removed from the anus of a cat a fish-hook, which had passed through the entire digestive tract. Jansen found the skull of a foetus in a sow's rectum; the skull had, during parturition, penetrated from the vagina into the rectum.

The anus is also liable to be injured during delivery. The perineum and, under certain circumstances, the sphincter ani may be simultaneously ruptured; in oxen, horn-thrusts are often responsible for these accidents.

The course of such injuries depends principally on their seat and extent. Wounds penetrating the peritoneal cavity always end fatally; and those caused in mares and cows by pressure of the penis are nearly as dangerous, though cows have been seen to recover. On the other hand, sudden death attributable to shock has sometimes been noted. Mares may die within twenty-four hours; cows may survive longer. Passage of the penis into the rectum is not, however, always followed by rupture—injury depending chiefly on the degree to which the rectum is filled with faeces. Wounds from the clyster syringe generally end fatally, and particularly if drugs have entered the peritoneal cavity.

Injuries of the posterior portion of the rectum lying beyond the peritoneal cavity, though certainly not so dangerous as the above, are yet apt to lead to septic cellulitis in the connective tissue around the rectum (paraproctal connective tissue), and may be followed by fatal consequences. But Hüppe's case shows that in the horse even extensive injuries at this point may heal. Injuries of the vagina are less dangerous, though sometimes followed by formation of recto-vaginal fistulæ.

Diagnosis is at once settled by exploration of the rectum and examination with the speculum, in cases in which colic, tenesmus, and blood-stained discharge occur. But before proceeding thus to determine the seat and extent of the injury, it should be ascertained whether manipulation of the parts has already been practised, and the owner should be informed of the possible existence of a fatal injury, so that the operator may not be suspected of having caused it. Complication with peritonitis is characterised by fever, small and frequent pulse, and slight but continuous colic, and in horses death occurs in a few days, often even in a few hours.

Wounds of the anus are only grave if the sphincter or perineum is divided. If no difficulty occurs in closure of the anus, wounds of this part heal easily and completely; only exceptionally does anal fistula result. The healing of ruptured perineum offers greater difficulty and, in mares, may result in sterility, but a cure is usually

effected by suturing the wound early, or even at a later period if the edges be freshened.

Treatment. Treatment of perforating wounds of the rectum is seldom desirable. Oxen and sheep are best killed at once. Should the attempt be made, the rectum must first be carefully emptied, food withheld, and water given only in small quantities. Clysters are better avoided, because they favour the entrance of bowel contents into the peritoneal cavity and peritonitis. Opium might possibly be of service on account of its checking the movement of bowel contents towards the injured spot.

In injuries of the pelvic portion treatment is more hopeful. The wound may be cleansed by clysters (which at the same time wash out the contents of the rectum), containing salicylic acid, or carbolic acid; in horses, diluted sublimate solution (1 in 5,000). Röder successfully sutured a recto-vaginal rupture; recovery followed.

Wounds in the neighbourhood of the anus may sometimes be sutured and bleeding vessels ligatured. Cold water clysters serve to check bleeding from the anterior parts of the bowel. It has also been suggested to introduce a bladder or rubber balloon into the rectum, and to exercise pressure on the bleeding vessels by inflating it or filling it with water; but its employment in animals is much limited by its causing severe straining, and thus often proving more dangerous than useful. The same is true of tamponing the rectum, though in extreme cases one might certainly try it.

As regards abscess-formation after injury to the rectum, see succeeding pages.

III.—INFLAMMATION OF THE MUCOUS MEMBRANE OF THE RECTUM AND ANUS (PROCTITIS).

APART from inflammation of the rectum and anus, produced by gross injuries, inflammatory processes are seen in severe intestinal catarrh, in dysentery, and after continuous diarrhœa, particularly in young pigs and dogs. The same result may be produced by clysters of too irritating a character, or administered too hot, by parasites, and by very large masses of fæces. Schwanefeld found a piece of broomstick, 8 inches in length, in the rectum of an ox. In dogs, bones and firm masses of fæces often produce inflammation of the mucous membrane.

Inflammatory disease of the anus in the horse has been seen after tearing away the larvæ of *œstridæ*, in carnivora in consequence of rubbing the anus to allay the irritation of pruritus. In long-coated

dogs the hairs in the neighbourhood of the anus sometimes stick together, close the anus, and produce inflammatory irritation, or the animals may suffer from inflammation of the anal glands.

Symptoms. Inflammatory disease of the mucous membrane of the rectum is characterised by tenesmus, that is, repeated but unsuccessful attempts to pass fæces. The animals stand with the back arched, and the continuous severe straining often leads to prolapsus ani or recti. The mucous membrane is more or less intensely reddened.

Injuries to the anus may be directly seen; and where the hairs have become adherent and occluded the orifice, the neighbouring skin appears reddened and often excoriated.

Disease of the anal glands may be recognised by inflammatory swelling; compression of the glands causes spurting of a purulent or hæmorrhagic fluid; defæcation is painful and often repressed; after some time fluctuation and perforation occur, and the swelling subsides, though relapses are common and sometimes cause laymen to suspect hæmorrhoids.

These conditions are seldom dangerous, but occlusion of the rectum and of the anus may result from chronic catarrh in young animals. Injuries sometimes lead to inflammation of the perineal or paraproctal connective tissue and thus cause trouble.

Treatment. Inflammation of the rectal mucous membrane is treated with mucilaginous and oily clysters; in larger animals starch paste is suitable. In dogs, lukewarm oil may be used, and when tenesmus is marked, opium can be added. Foreign bodies and hard masses of fæces should be removed cautiously. The long adherent hairs about the anus must be cut away with scissors, the anus cleansed, and powdered with some material like iodoform and tannin or boracic acid.

Suppurating anal glands must be opened, the contents removed, and, after thoroughly cleansing, the parts are dressed with iodoform, or boric vaseline. For inflammation produced by parasites, or by œstrus larvæ, lukewarm lotions and dusting powders are recommended. In all these diseases it is of importance to render defæcation as easy as possible. For this purpose suitable nourishment should be given, and clysters and laxatives administered.

IV.—INFLAMMATION OF THE CONNECTIVE TISSUE SURROUNDING THE RECTUM (PERIPROCTITIS OR PARAPROCTITIS).

THIS disease, though not common, is sometimes seen in large animals, and is caused by wounds of the posterior portion of the

rectum becoming infected. Metastatic abscesses have been seen here during the course of strangles. In females peri- or para-proctitis may result from injury of the vagina.

The loose connective tissue surrounding the end of the rectum appears particularly liable to cellulitis, and it depends principally on the action of the infecting material what course the disease takes. Most of the published cases have been due to simple purulent cellulitis, leading to formation of abscesses.

The course of the disease depends on where the abscess perforates ; should it discharge into the peritoneal sac, death from purulent peritonitis is inevitable ; but when perforation occurs into the rectum, or the abscess is punctured from this point, recovery often follows. The case is still more favourable where the discharge occurs outwardly beside the anus. Wilke succeeded in opening the abscess from the vagina, a method which deserves preference, as avoiding the bad results of perforation outwardly or into the rectum. In the latter case there is always danger of the formation of anal fistula.

Symptoms. Periproctitis is first announced by interference with the passage of fæces, caused by swelling and abscess formation. The animals show slight but continued symptoms of colic ; defæcation is difficult and painful, and is either suppressed or accompanied by groaning. There is usually slight fever. Only where cellulitis extends to close under the outer skin does swelling occur in the neighbourhood or at the side of the anus. From here infection may extend under the fascia and between the muscles of the thigh, and cause further suppuration, emphysema and lameness.

Exploration per rectum determines the extent and position of the disease. The posterior portion is empty, but in front of this the bowel is swollen and its lumen narrowed. In a case of Möller's in a horse, a painful fluctuating swelling, almost as large as a child's head, could be detected on the upper wall of the rectum, about 8 inches from the anus. This had so diminished the passage that there was scarcely room below to pass two fingers. The rapid development of the symptoms, the soft, fluctuating, painful character of the swelling, and the moderate fever, distinguish the condition from tumour formation.

Treatment. When an abscess has already formed, and attention been called to its existence, nothing usually remains but to give exit to the pus, and as it is of importance to effect this in the least dangerous way, the path usually chosen is that through the vagina or the skin and tissue lying around the rectum. The latter is preferable if the abscess be close to the anus, and the puncture must be made

as low as possible to favour drainage. If possible, division of the sphincter ani must be avoided. In females the vagina forms a convenient and safe route for arriving at abscesses lying below the rectum. Wilke punctured the abscess wall through the vagina with the finger, and emptied an abscess the size of an ostrich egg, which lay about 6 inches from the anus.

In purulent cellulitis affecting the upper wall of the rectum, drainage into the bowel should only be chosen when the abscess cannot be punctured from without. In the above described case, Möller opened the abscess with a bent trocar (Flourant's), and gave exit to about 2 litres of thick offensive pus, containing fragments of necrotic tissue. As the abscess had refilled next day, the opening was lengthened with a button-pointed tenotome, introduced into the rectum with its cutting surface covered by the hand. Complete recovery took place in three weeks.

After incising the abscess, the cavity must be carefully washed out with a strong stream of disinfecting material, so as to remove necrotic portions of tissue, and precautions taken for securing drainage of pus. Relapses, however, are common; in a case described by Verlinde pus formation extended downwards as far as the Achilles tendon; nevertheless, the animal eventually recovered.

V.—PROLAPSE OF THE RECTUM AND ANUS (PROLAPSUS RECTI ET ANI).

PERMANENT protrusion of the mucous membrane of the rectum through the anus is described as prolapsus ani. As the membrane appears after each act of defæcation, prolapsus ani really consists only in the abnormal persistence of a physiological condition. This protrusion of the mucous membrane is most distinctly seen in horses, and in them prolapsus ani is rather frequent, but it also occurs in dogs and other domestic animals.

When not merely the mucous membrane but the entire intestinal wall passes the anus, the condition is termed prolapsus recti. The posterior end of the bowel can only pass the anus after rupture of the periproctal connective tissue, but those portions of bowel normally clothed with peritoneum sometimes pass through the pelvic portion and anus, after becoming invaginated in the last part of the rectum, constituting a third condition—prolapse with invagination. We therefore distinguish—(a) Prolapsus ani. (b) Prolapsus recti. (c) Prolapsus recti cum invaginatione. Prolapse of the anus and of the rectum generally results from severe diarrhœa, particularly if

accompanied by tenesmus. The disease is favoured by weakness, with relaxation or paralysis of the sphincter ani. It is commonest in young animals, but in swine it also occurs at a later period.

As a rule, the immediate cause is increased abdominal pressure, as in slinging, though inflammatory swelling of the mucous membrane of the rectum may cause prolapse, and both these have been seen after use of irritant or excessively hot clysters. Prolapse also appears during colic or obstruction of the bowel, sometimes in difficult parturition; in cows in connection with prolapse of the vagina, and in horses from halter casting, or from violent struggling during operations. In two cases noticed by Mauri, which occurred during castration, the prolapsed rectum was ruptured, and coils of small intestine protruded through the opening.



FIG. 421.—Prolapsus recti with invagination in the bitch (semi-diagrammatic).

Symptoms. In prolapsus ani, a red, slightly painful, hemispherical swelling of the mucous membrane appears at the anus, and shows at its centre a shallow depression; sometimes only a few folds appear at one side. In simultaneous prolapse of portions of the rectum (prolapsus recti) the swelling is larger and harder, but even then does not attain the size usual in prolapse complicated with invagination, where a portion of bowel several yards in length may hang from the anus. In dogs, Möller has repeatedly seen prolapses 12 to 20 inches in length. On account of the tension on the mesentery, the prolapsed portion sometimes becomes twisted upwards in horses (Fig. 422).

When the prolapse attains such dimensions no doubt can exist in diagnosis, but it is otherwise when only small portions of bowel

project beyond the anus. In simple prolapsus ani et recti the ring-shaped swelling shows an opening at its centre, through which fæces are discharged ; at its periphery it is impossible to pass the finger towards the pelvis. The case is different where prolapse is complicated with invagination ; then the finger, and in large animals the entire hand, can be introduced alongside the prolapsed part into the pelvic portion of the rectum. It is of importance to note this, as it at once differentiates the two conditions, and affords important indications for treatment.

Progress. Prolapse of the anus is usually reduced by laymen



FIG. 422.—Prolapsus recti with invagination in the horse.

without skilled assistance, and only when it continually recurs and the mucous membrane becomes greatly swollen, or when it has persisted for a long time, does it become the subject of skilled treatment. Frey saw a horse which had difficulty in defæcation in consequence of prolapse ; others have erroneously described chronic prolapses as hæmorrhoids. The mucous membrane undergoes change from continued exposure to the air ; it becomes thickened, dry, necrotic, and may slough, thus eventually bringing about spontaneous recovery from the prolapse. Groll saw a pig with prolapse ; twenty days later the protruded part sloughed away spontaneously, and recovery followed.

The above is also true of prolapse of the rectum with invagination, except that as a rule defæcation is difficult, the passage of material being interfered with in the invaginated portion of bowel. The animals strain severely, causing further portions of intestine to protrude, these soon become œdematous, the folds in their mucous membrane disappear, and the surface of the prolapsed portion consequently appears smooth. The surface of the bowel, which is dirty and not infrequently injured by the animal rolling or lying, gradually becomes dry and presents a dark red or black colour. Pigs sometimes bite off the prolapsed portions in other pigs.

Death is generally due to injury followed by infection of the prolapsed bowel. No particular demonstration is required to show that prolapsus ani involves less danger than prolapsus recti, especially when the latter is complicated with invagination, and though spontaneous healing sometimes occurs, by the necrotic portion of bowel sloughing, it is very exceptional. Prolapses of the anus are most easily healed, when they have persisted for a short time only, and the mucous membrane of the protruding part is not much altered. Should prolapsus recti be complicated with invagination, and have existed for several days, reposition becomes impossible, because the peritoneal surfaces have already become either adherent or united.

Herbivora withstand the condition far better than carnivora. In dogs, invagination is very general, and the commonest subjects are weakly animals, or those whose constitutions have been lowered by continued diarrhœa, as Haubner has already noted. Pigs bear prolapse better, but horses frequently die of it, while oxen generally recover.

Treatment. In recent prolapse the mucous membrane is cleansed and replaced by regular and steady pressure with the hand, or in small animals with a finger. Sometimes this requires to be repeated, and the owner or attendant may be instructed how to carry it out. Tenesmus is combated by clysters of mucilaginous or oily fluids, containing, if needful, opium; cocaine may also be worthy of trial. Diarrhœa must be treated by suitable diet and internal medication. Should the prolapsed mucous membrane be swollen, scarification and bathing with astringents as 2 to 5 per cent. alum solution will facilitate reposition. Continued recurrence or structural change in the mucous membrane may necessitate surgical removal of the protruded part.

The procedure is the same in simple prolapsus recti, but prolapsus recti with invagination offers greater difficulty. In such case reposition must be effected as soon as possible, for the longer prolapse

exists, the greater the difficulty and the less the chance of success, though even in these cases cure is occasionally effected. Larsen immediately reduced a prolapse, about 32 inches in length, which occurred during the castration of a horse, caused an assistant to keep the anus closed, and completed the interrupted operation. When the animal rose, the prolapse had disappeared and did not recur. In reposition care must be taken simultaneously to reduce the invagination. For this purpose it is not sufficient to thrust the protruded bowel through the anus, but the extreme end must be carried forward at least twice the length of the prolapsed part. In large animals this is best effected with the arm, in the smaller (dogs) by means of a tallow candle. Stockfleth used a stick; the end covered with tow and rubbed with fat. Infusions of warm water injected whilst the hind-quarters are raised may also assist reduction. Horses should be cast and anæsthetised, and after reduction has been effected, they should be kept down for 5 or 6 hours and, if necessary, given a narcotic. When the animals strain violently, narcosis must be resorted to, for which purpose chloral or morphine is very useful. The greatest obstacle to reposition and permanent cure lies in severe straining. Large animals should, therefore, be watched for some hours, and if it sets in, pressure should be exerted over the loins. Mild clysters and the application of cold combat inflammatory symptoms about the anus and rectum.

To ensure retention, the anus may be sutured. Strebel inserts two strips of leather in the neighbourhood of the ischial protuberances, and crosses them over the anus; by applying tow or sponges below these the intestine is held back; in horses, the tail has been fastened so far forward with straps as to exercise pressure on the anus. André's "tobacco-pouch" suture has been strongly recommended. This is a continuous suture, made by passing a narrow tape in and out under the skin, and working in a circle; it should be left in position for twenty-four to thirty-six hours. To allow of defæcation the tape is, when necessary, loosened, and afterwards again drawn tight and knotted. It is clearly not to be employed in cases of invagination where its use would be irrational. Cocaine suppositories may be tried in severe straining.

When prolapse with invagination has already existed for several days, reposition becomes impossible, nor should it be attempted if structural change has occurred. Nothing, then, remains but to remove the protruded portion, for which purpose one of the following methods may be employed, viz. :—

(1.) The use of irritants. Jessen powders the protruded parts

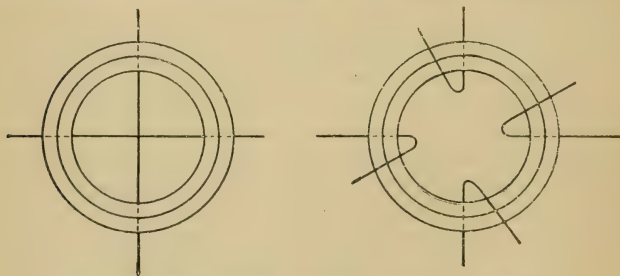
four or five times a day with sulphate of copper and pulverised charcoal in equal parts; inflammation results, and in a few days a scab forms, after which the prolapsed part sloughs off in eight to fourteen days. Danish practitioners have used this material with success in large animals and swine, but others consider it useless;



FIG. 423.
Stockfleth's wooden
ring.

Weber, after trying it in foals was finally forced to operate. It can, of course, only be used in prolapsus ani et recti, without invagination. Apart from the uncertain action of this treatment, it must be remembered that it is often followed by extensive contraction of the anus and difficulty in defæcation, and most practitioners, therefore, prefer amputation.

(2.) Ligation has been adopted by Viborg and Stockfleth in the case of pigs, dogs, and foals. As it is necessary to keep the anus open for the passage of fæces, Stockfleth binds a ring of wood, 1 to 2½ inches in diameter, in the anus; to prevent the ligature slipping off, the ring has a shallow groove on its surface (Fig. 423). The prolapse is divided up to the anus, the ring then thrust in, and a stout ligature passed around it and the prolapsed bowel, which slowly cuts through, until finally the portion of intestine



FIGS. 424, 425.—Method of ligation in prolapsus recti.

beyond the ring is cut off. During the next few days defæcation must be assisted by clysters, and bulky and indigestible foods avoided. The tube falls away spontaneously in five or six days, and as a rule healing is then complete. Sørensen in this way amputated a piece of bowel, weighing 23 ounces, in the horse. A case of Johnes's, however, in the pig, shows that after ligation stenosis, and even complete occlusion, may occur.

(3.) Multiple ligation. If the layers of bowel are not completely

united to one another, or at any rate not firmly adherent, there is considerable risk of opening the peritoneal cavity when practising this method.

The simple cobbler's stitch is often recommended. A transverse incision is made through the upper half of the protruded bowel, close behind the anus, and the two layers of tissue in front of the incision united by closely applied ligatures. The lower half is then divided and the ligaturing continued until finally the protruded portion of bowel is completely divided and removed. The simultaneous division and ligation prevents the end of the bowel not yet firmly fixed by sutures slipping back into the peritoneal cavity, and producing fatal peritonitis.

In dogs and pigs the following method can be employed. The protruded piece of bowel is transfixed close behind the anus with two needles arranged crosswise, and provided with two long threads (Fig. 424). The prolapsed part is then cut through, about $\frac{1}{2}$ to $\frac{3}{4}$ of an inch behind the threads, which are then drawn forward out of the intestinal opening. By dividing these in the centre, one has four threads (Fig. 425), which when united form four stitches, and are generally sufficient. Should it be seen on cutting away the posterior part of the bowel that union is still incomplete, two other stitches can be inserted between each pair of those previously existing, thus forming eight ligatures, which are sufficient even in large animals. Savournin saw a horse in which the rectum had already become necrotic, but by ligaturing it in two portions he effected complete healing in twelve days. In the case of a mare, Grammlich gave chloroform and then performed multiple ligation, cutting off the prolapsed portion of bowel about half an inch behind the ligatures. The bowels did not act naturally (*i.e.*, without assistance) for six weeks. It is scarcely necessary to add that, both in selecting the ligature and in carrying out the operation and after-treatment, it is necessary to practise antisepsis as far as possible. To facilitate ligation Reuter recommends thrusting into the lumen of the prolapsed bowel a conical piece of carrot, turnip, or even of soap, before commencing the actual insertion of the ligatures. In swine Olivier divides the prolapsed bowel in its long diameter and ligates the two pieces separately.

(4.) In old cases of prolapse, where union between the layers of peritoneum is complete, and no chance exists of opening the peritoneal cavity, simple excision of the prolapsed part with suture of the ends is sufficient. This method has been used in swine, but caution is required; simple or multiple ligation is greatly preferable.

VI.—CONTRACTION, DILATATION, STENOSIS, AND PARALYSIS OF THE RECTUM AND ANUS.

AFTER operation for atresia ani, amputation of prolapsed portions of the rectum, and injury to the anus, cicatricial contraction sometimes occurs, causing marked stenosis and difficulty in defæcation. Sometimes the anus is completely closed, as in Johne's case, in a six months old pig after ligation of the prolapsed rectum, or in Volk's in a pig, where the same accident followed spontaneous sloughing. Occlusion of the rectum occurs, both in pigs and dogs, in consequence of chronic diarrhœa, particularly during the first years of life; the epithelium is lost, the opposing mucous surfaces become adherent, and finally unite.

Cicatricial contraction of the rectum may also result after injury or ulceration of its mucous membrane, and cause stenosis, or new growths, within or without the bowel, may compress it and narrow its lumen.

Johow saw a cow which stood with the back arched and continually attempted to defæcate; a ring-shaped stenosis of the rectum existed at the entrance to the pelvis, and was barely large enough to admit two or three fingers; the rectum was greatly distended in front of the spot, which was about half an inch wide. After incising the stenosis and using clysters, a cure was effected. The nature of the case seems obscure.

Rogerson diagnosed in a mare and a foal, which both suffered from stoppage of the bowel, well-marked stenosis of the rectum about 20 inches in front of the anus; the post-mortem examination showed the rectum to be greatly thickened, of cartilaginous consistency, and to some extent ossified. Johne saw the same condition in a cow, Meyer in a horse. Gurlt found the rectum of a foal so narrow that only a strong goose-quill could be passed through it.

Pathological dilatations of the pelvic portion of the rectum are not infrequent in horses. They are seldom partial—so-called diverticula—but usually the entire pelvic portion is dilated. They are oftenest seen in old horses which have long been fed on bulky food, and in dogs which have suffered from habitual constipation or enlargement of the prostate, which interferes with defæcation; dogs also show this dilatation in hernia perinealis. Old horses often suffer from extensive dilatation of the pelvic portion without showing distress, though they have difficulty in defæcation, especially if paralysis of the rectum accompanies dilatation.

Hengst speaks of an old horse which suffered from colic, and showed a rectal sacculation 12 inches in front of the anus, which was the size of two fists and filled with fæces. After emptying and washing this out, the colic disappeared. Martin noted the formation of a diverticulum in a horse after injury to the rectum; 16 inches in front of the anus was a wound about 6 inches long and 2 broad, which caused severe fever and

colic; it was washed out with solutions of boric acid and permanganate of potash, and later of carbolic acid. Cicatrisation occurred, but a diverticulum as large as a man's fist formed, from which the dung had to be daily removed. Stockfleth described in a horse a diverticulum which lay on the upper wall of the rectum about $5\frac{1}{2}$ inches from the anus, and opened into the lumen of the bowel by means of a narrow slit. Möller found one about the size of a hen's egg in a Dalmatian dog on the left wall of the rectum, close in front of the anus, which was thrust forward during defæcation, and was filled with soft fæces. This was possibly an enlarged anal pouch; but as the dog was only seen during life, the point could not definitely be decided.

Paralysis of the rectum is generally associated with paralysis of the tail, or of the bladder and hind legs, and apart from the general paralysis caused by fractures of the vertebræ, &c., occurs most frequently in the horse. It is particularly frequent in mares. Harms found rectal paralysis in a cow to be due to fracture between the sacrum and first vertebra of the tail. Though this paralysis is usually spontaneous, the immediate cause can often be traced to severe bruising or injury in the lumbar region. In the army reports, the following case occurring in a seventeen-year-old mare is given:—The animal showed paralysis of the rectum and bladder, with atrophy of the muscles of the quarter and thigh, and was found, on post-mortem examination, to have thickening of the spinal dura mater from the 3rd lumbar vertebra backwards. The grey substance of the spinal cord appeared lighter in colour, and softer than usual. A considerable quantity of red fluid was found between the meninges of the spinal cord.

Friedberger saw the condition during the course of contagious pleuro-pneumonia in the horse. We have repeatedly seen paralysis of the rectum develop spontaneously and quite gradually, and affect the rectum, tail, bladder, and, later, the hind-quarters, but only in non-pregnant mares; generally in well-bred animals. The first change appears to be paralysis of the lumbar nerves, followed by accumulation of fæces in the rectum and gradual dilatation of that bowel.

The rectum receives its nerves from two points: the n. hæmorrhoidalis medius, a branch of the pubic nerve, gives twigs to the curvator coccygis and retractor ani; the n. hæmorr. posterior arises from the 4th and 5th lumbar nerves, and supplies the terminal portion of the rectum and the retractor penis muscle. The depressor coccygis derives its motor twigs from the 5th lumbar nerve, while the levator coccygis is supplied from the last twigs of the spinal nerves, the so-called cauda equina. In the cases noted the disease began with paralysis of the levator coccygis, but the rectum and bladder were only affected after several months. Finally, the general paraplegia necessitated slaughter or total withdrawal of the animal from work. Unfortunately, post-mortem examinations were not made, but the course of the disease points to progressive degeneration of

the posterior portions of the spinal cord. The observations of others and the above-described post-mortem appearances support this view. Peters saw the disease associated with paralysis of the bladder in a mare. Schwarznecker observed the same condition in a pregnant mare, which later died from paraplegia; the post-mortem gave a negative result. Deigendesch reports a similar case; the mare died from rupture of the bladder. Dollar has seen the condition after severe attacks of contagious pneumonia (influenza).

Symptoms. Abnormal dilatation of the rectum first attracts notice on account of the large quantities of fæces which are passed, and the long intervals between the acts of defæcation, which only becomes difficult when actual paralysis has occurred; the rectum is then distended with dung, which requires to be removed manually. Cases occur which require to be daily assisted in this way. Sometimes paralysis of the levator coccygis exists simultaneously, and then the tail swings to and fro as the animal walks, and the hair becomes soiled with fæces. After a certain time incontinence of urine sets in, the bladder becomes distended, and urine flows away continuously (ischuria paradoxa); still later sacral paralysis with atrophy of the muscles of the haunch occurs (compare with sacral paralysis). Sometimes pruritus exists about the hind-quarters.

The disease takes a chronic course and treatment has no visible effect, but however slow its progress, the animals finally become useless, and may even die of the disease.

Dilatation of the anus is commonest in animals which have long suffered from severe diarrhœa, or been much weakened by internal diseases. Even after prolonged rectal examination, when the arm has been in the bowel for a considerable time, paralysis of the sphincter ani may persist for several days; the anus remaining open, and the air, which streams in and out during breathing, producing a loud noise.

Stenosis of the anus and rectum soon impedes defæcation and attracts notice; the position, degree, and extent of the condition are at once recognised on local examination. Hönisch saw a horse which had long shown difficulty in passing fæces; it placed the hind feet as far forward as possible and discharged single small, hard masses. The post-mortem discovered cicatricial stricture and thickening of the rectum, which extended about 5 inches forwards from the anus. It has been said that chronic inflammation in the paraproctal connective tissue may cause stenosis, but as a rule the cases published throw no light on the question.

Prognosis is guided by the above-mentioned facts. Though usually unfavourable, the animal's usefulness depends on the primary disease and the work to be done. Complete and lasting cure is seldom

to be expected, but Harms's case of paralysis of the rectum in a cow, resulting from fracture between the sacrum and first coccygeal vertebra, recovered in a month. A case is also described in the annual report of the Prussian army, where a horse recovered in three weeks from paralysis of this nature following a fall.

Treatment. Cicatricial stricture of the anus and posterior section of the rectum may be temporarily relieved by forcible dilatation; in man, bougies are employed, but their use in animals is attended with difficulty, and is only justified when, for instance, a favourite and very valuable dog is in question, for whose recovery every means must be employed. Bougies consist of cylindrical hollow or solid rods, formed of hard rubber, or of material similar to that of which catheters are made. To be successful they require to be very frequently passed. Another method is forcibly to dilate constrictions with forceps. Johow relates having, after incision, dilated with the hand a firm ring-shaped stricture in the rectum of a horse. Volk cured a pig whose anus had closed, after prolapse of the rectum, by making a cross-shaped incision over the anus and breaking down the adhesions.

Constipation, following either constriction or dilatation, is treated by suitable diet and the use of purgatives or clysters; the intestinal contents being softened by copious injections of lukewarm water. In advanced cases of dilatation or paralysis, the rectum requires to be emptied once or twice daily. To combat paralysis all kinds of drugs, the induced electric current, &c., have been tried, but without success. Deigendesch tried strychnine without good result.

VII.—ANAL FISTULA AND RECTO-VAGINAL FISTULA.

ALL fistulæ in the neighbourhood of the anus are described as anal fistulæ. Where a communication exists between the skin and rectum, the fistula is termed "complete," where one end is blind, "incomplete." Sometimes one end communicates with the rectum, the other with the vagina (Fistula recto-vaginalis). The latter is sometimes congenital, but also results from injuries, particularly during delivery.

Injuries and cellulitis of the paraproctal connective tissue are the common causes of anal fistula, but the condition may be congenital and associated with atresia ani. Operation is the only effective treatment, and in the case of recto-vaginal fistulæ frequently fails.

Schrader, in a six-year-old mare, observed recto-vaginal fistula of a diameter of $1\frac{1}{4}$ inches, about 4 inches in front of the anus. Meer found a similar one, which had appeared after delivery, 3 to 4 inches in front of the anus in a mare. Munkel observed in an ox a "complete" anal fistula,

the rectal opening 6 inches in advance of the anus, the second on the lower surface of the tail. "Incomplete" anal fistulae in horses have been seen by Hertwig; one was 12 inches, the other 16 inches in length, and both had resulted from abscess formation. Novotny describes a fistula communicating with the rectum, and extending between the semi-tendinosus and biceps femoris muscles.

Diagnosis may be confirmed by probing the channel while a finger is inserted in the rectum; if the fistula is complete, the finger will encounter the end of the probe, and the position of the opening of the fistula will be discovered. Sometimes, owing to the sinuous course of the channel or the existence of branches, exploration by probing is unsatisfactory, and more information can be obtained by injecting the fistula with coloured fluid.

Treatment. To prevent anal fistula, proper treatment of wounds, &c., is very important, and injuries of the vaginal walls during delivery must receive special attention.

It is possible to bring about closure by injecting irritants like liquor Villati, iodine, sublimate and zinc chloride; but when fistulae extend into the rectum, or far forwards in the paraproctal connective tissue, the use of irritants is dangerous, on account of the possibility of their reaching the peritoneal cavity. Operation with free exposure of the fistula is therefore preferable. If possible, the sphincter ani must be spared, though its section often produces no lasting inconvenience, and union becomes quite perfect. Munkel divided the sphincter without bad results; Hertwig endeavoured to spare it as far as possible. In laying open a "complete" anal fistula a grooved director is inserted, the end of the fistula discovered by inserting the index finger of the left hand in the rectum, and an incision then made down to the finger, care being taken to spare the soft parts as much as possible, and so regulate the cut as to favour wound drainage. Roupp passed a lead wire through a "complete" rectal fistula, drew one end back through the anus, and laid open the fistula by daily tightening the wire about an inch. Novotny secured healing in one case by drainage. Cauterization of the fistulous track by means of a thick wire or steel probe, heated to a bright red, may succeed when other treatment fails. Röder sutured a recto-vaginal fistula but only obtained partial union. Short recto-vaginal fistula may sometimes be closed by passing a seton; the larger lying near the vulva may be sutured.

VIII.—TUMOURS IN THE RECTUM AND ANUS.

IN dogs fibromata, sarcomata, carcinomata, and adenomata are not infrequently seen in the paraproctal connective tissue; while

horses, particularly those of a grey colour, suffer most from melano-sarcomata and melano-carcinomata. Various tumours are also found in the rectum. Kitt saw many cases of mucoid polypi of which several sloughed away, and on examination revealed the presence of Lieberkühn's glands. Kitt therefore regarded them as œdematous folds of mucous membrane (*pliceæ polyposæ*). He also saw adenomata, adeno-carcinomata, and true carcinomata. According to his view the sarcomata originate in the lymph follicles of the rectum. Scott endeavoured to remove from beneath the sacral region a sarcoma which interfered with defæcation; death from septicæmia resulted. Teetz saw cysts and pedunculated polypi in horses, Carougeau collections of varicose veins in dogs.

Symptoms and course. Warts on the anal margin, and tumours near the anus and close below the skin may be directly seen and felt, but the veterinary surgeon is seldom called in until stenosis or displacement of the rectum or anus interferes with defæcation. Tumours in the posterior portion of the rectum sometimes protrude during defæcation, and occasionally cause prolapsus ani. When further forward, they are either accidentally discovered in examining the rectum, or the continuous and gradually increasing difficulty in defæcation draws attention to them.

Manual examination determines their size, form, and position; sometimes the rectal or vaginal speculum is useful.

Inflammatory swelling of the anal glands, common in dogs, may be mistaken for tumour formation, though the local pain sufficiently indicates its nature. Rectal and anal tumours, especially when malignant, are often accompanied by secondary growths and swelling of the lymph glands in the abdomen.

Prognosis depends chiefly on the difficulty of extirpating the cyst or tumour. Not only must the nature of the new growth, and its position and size, be borne in view, but the question whether secondary growths or infection of lymph glands has occurred must be considered. Tumours near the anus may easily be removed if not adherent to the mucous membrane of the rectum, a point which can at once be settled by introducing the finger or hand. Pedunculated tumours within the rectum offer no difficulty in removal, but those with broad bases are often impossible to extirpate.

Treatment. Warts and other benign growths originating in the skin are simply removed with knife or scissors. Those growing from the subcutis or paraproctal connective tissue, if only small and not attached to the mucous membrane of the rectum, are treated in the same way. After incising the skin with the usual precautions, the tumour is

drawn well forward, either with forceps or by passing a tape through it, and dissected out without injuring the rectal mucous membrane. Tumours in the rectum itself are extirpated either by ligation or the *écraseur*. Polypi may be removed by traction, or by torsion. If the pedicle is thick it should be ligatured and after an interval of two or three days the tumour can be safely removed by torsion. Cysts are treated by puncture followed by injection with solution of iodine ; or they may be opened widely or partially excised. Serious bleeding is rare, and such as occurs can be controlled by cold clysters or tampons.

Frey states having noted in the horse, close in front of the anus, two sarcomata (?) which produced prolapsus ani. Köhne removed from the rectum of a horse by ligature a polypus whose seat was 4 to 5 inches in front of the anus, through which it protruded during defæcation. In a second horse Köhne removed with the *écraseur* a polypus the size of a man's fist, which lay about 16 inches forward from the anus. Stockfleth states having seen cancer of the rectum in old cattle. Siedamgrotzky discovered in a gelding a cyst as large as a man's fist lying on the lower wall of the rectum 6 inches from the anus ; it discharged a clear fluid on perforation with the trocar. After injecting tincture of iodine, healing occurred. A similar case is described by Hierholzer.

Truelsen removed from the rectum of a foal several polypi, which lay about two hands' breadths from the anus, and had repeatedly caused constipation and colic. An improvised *écraseur* was constructed of a cannula and wire, with which Truelsen removed the growth, and effected a cure.

Fröhner removed from a horse a serous cyst which had its seat on the upper wall of the rectum about 4 inches from the anus ; he applied a silk ligature and snipped off the growth with scissors. Teetz, in a case in the horse, laid open the cyst and obtained healing.

Hæmorrhoids, or varices of the rectum, only occasionally occur in horses, cattle, or dogs. Frequently the condition due to proctitis, congestion of the mucous membrane, or inflammatory swelling of the anal glands in dogs, is mistaken for hæmorrhoids. But dogs sometimes suffer from varicose veins inside or outside the anal sphincter, and if not speedily relieved, abrasion, ulceration, fissure or sinus formation may ensue. Hæmorrhoids cause much irritation, hinder defæcation, are painful and often associated with constipation, in old dogs with liver or cardiac disease, and frequently they bleed during the passage of fæces. Treatment is both general and local. In most cases regular exercise and laxative diet are beneficial, while attention is given to the state of the liver, heart and bowels. Locally, injections of warm water and glycerine, or olive oil, are indicated. Abrasions and ulcers must be cleansed and disinfected ; and to allay the pruritus, which is often troublesome, a pomade, containing belladonna and cocaine, may be applied. In some cases precipitated sulphur forms the best dressing. Excision of the hæmorrhoid, by the knife or thermocautery, may be required. Bleeding is controlled by inserting in the rectum a plug of gauze saturated with adrenalin solution.

Carougeau successfully operated on a mass of varicose veins involving the rectum and lower surface of the tail in a horse.

DISEASES OF THE URINARY ORGANS.

I.—CONGENITAL MALFORMATIONS.

(1.) FISSURING OF THE MALE URETHRA (HYPOSPADIA AND EPISPADIA.)

IN consequence of arrested fœtal development the urethra may fail to entirely close at some point in its course, and thus present the appearance of an open channel. When this occurs in the posterior, lower wall, the condition is termed hypospadias, when in the upper, anterior wall, epispadias. In animals, neither condition has the same significance as in men, as the patients, which are usually dogs or sheep, are either destroyed or left without treatment. Horses are seldom affected. The abnormal opening may lie just behind the glans, or in the course of the urethra nearer the bladder; where it occurs close below the anus, the animals are sometimes mistaken for hermaphrodites. Hypospadias is not infrequently associated with cloaca formation, as noted by Möller in the case of a dog which appeared to suffer continuously from sexual excitement. Guinard saw hypospadias in a three-year-old cryptorchid bull.

Treatment is seldom called for unless the condition is accompanied by difficulty in urination. The natural opening of the meatus urinarius may not exist, and if the fissure is insufficient for the discharge of urine, it may require enlargement. To prevent reunion of the parts the meatus is divided from below upwards in the form of a "Y," and the edges attached to the skin.

(2.) PERVIOUS URACHUS.

Up to the time of birth urine is discharged through the urachus, but when that closes the urine passes through the meatus urinarius. In a few cases the urachus remains open even after birth, and urine is discharged through it. Burmeister saw this in a three weeks old foal; when staling, some urine always flowed from the navel. In a colt described by Herbet urine was only passed by the urethra in drops, but flowed in a stream from the opening in the navel, which was about $\frac{1}{8}$ inch across. Kauffmann and Blanc found the following conditions existing in a thirty-seven days old calf—atresia ani; hernia, as large as a child's head, in the linea alba, between the navel

and os pubis ; a fissure 2 inches long, in the umbilical region, through which both the open meatus urinarius and the urachus opened ; fæces were discharged by the latter ; a canal, the size of a goose-quill, existing between the occluded rectum and the bladder, whence the material made its way into the urachus. The latter also received the ends of the ureters and spermatic ducts. Lancelot saw in calves and goats swelling of the navel, which to the touch gave the impression of an umbilical hernia. Several animals died because the urine found no exit through the urethra, and as the umbilical cord was also closed, the urine accumulated in its dilated end below the skin of the umbilicus. Greve found pervious urachus in a filly.

The primary cause of disease is the obstacle to discharge of urine through the urethra, and attention should, therefore, first be directed to this point. When no obstruction can be detected, blistering the navel will sometimes close the urachus ; Burmeister succeeded in this way. Should it prove impossible to open the urethra, the urachus may be further divided and the urine thus allowed to escape, a method which does well enough in animals intended for early slaughter. Herbert effected healing in five days by powdering the parts with burnt alum ; March, in the case of a calf, by applying a ligature. In foals disinfection followed by trancurrent firing of the orifice may be successful.

II.—URINARY CALCULI.

URINARY calculi have only a surgical interest when occurring in the urethra or urinary bladder. They result from materials deposited through the urine accumulating around hard substances, foreign bodies, clots of blood, masses of mucus, &c., which have found their way into the urinary passages ; catarrh or inflammation of the urinary passages, therefore, often gives the first impulse to their formation. Calculi are also said to be due to an abnormally high percentage of salts in the urine, produced by food and water rich in lime and to a specific tendency (lithiasis). Of more importance is the fact that retention and decomposition of the urine are liable to cause an alkaline reaction and calculous deposit. Such conditions are, therefore, to be provided against or removed as soon as possible, and care taken to disinfect catheters, &c., before use, and so prevent micro-organisms being carried into the bladder. Sometimes deposits occur in the pelvis of the kidney, pass into the bladder, there become enlarged, or being discharged with the urine remain fixed in the urethra. This explains why the symptoms of

urethral calculus generally appear suddenly and are apt to recur, and why the stone is almost always found at the narrowest point of the tube. In horses urinary calculi are often single, in cattle generally they occur in large numbers, or as so-called gravel.

In herbivora, urinary calculi most frequently contain triple phosphate and carbonate of calcium; in sheep, some have been found to consist of silicic acid, with phosphates of calcium and magnesium. Urinary calculi in herbivora are sometimes coloured red by iron salts; their surface is generally smooth, though those covered with oxalate of calcium are rough and uneven. In carnivora one distinguishes:

(a) Uric acid calculi, which consist of phosphate and carbonate of calcium and of urate of ammonium. These often attain considerable size, and appear smooth and white on the surface. V. Rátz believes they result from acid formation in the urine leading to deposit of calcium salts or to a basic condition of the urine.

(b) Oxalic acid calculi consisting of oxalate of ammonia are usually coloured yellow; their surface is rough, resembling a mulberry. Rátz considers that oxalates are excreted when the food contains quantities of oxalic salts, but they may also be formed in the body by the decomposition of urinary acids. The excretion of oxalic acid in consequence of diseases of the organs of respiration and digestion, which has often been suggested, is denied by Rátz.

(c) Cystin calculi are principally formed of cystin, are yellow, soft, and when dried are friable, and feel greasy to the touch. Concretions, consisting of epithelium mixed with lime salts and fatty crystals, are sometimes found in the urinary passages. As urinary calculi are of varying importance in the different classes of animals, and from a surgical point of view require particular treatment, we shall here view them under separate heads.

(1.) URINARY CALCULI IN THE HORSE.

Urinary calculi rarely occur in the ureters of the horse, still less frequently in the comparatively wide urethra. According to Bang the diameter of the latter in male animals is as follows:—In the pelvic portion 1 to $1\frac{1}{2}$ inches, in the abdominal portion $\frac{1}{4}$ to $\frac{5}{8}$ inch, behind the external opening $\frac{1}{2}$ inch. In mares the urethra is very wide, and calculi never remain fixed in it, and therefore in them vesical calculi alone claim consideration.

Urethral calculi may be recognised in the stallion and gelding by dribbling or difficulty in urination. The animals place themselves in position to urinate, but can only discharge fluid in drops or in a small stream. Sometimes the upper sections of the urethra are abnormally distended, or may be felt to contain a stone, and the catheter, when introduced, strikes on a hard substance. Examination per anum discovers the urinary bladder to be greatly over-filled, but on pressure, urine either fails to be discharged or issues in drops.

Vesical calculi take longer to produce obstruction in staling; the urine is passed more frequently, but in small quantities, often constantly in drops. When the animal has been driven fast, the fluid may be blood-stained on account of the stone injuring the mucous membrane. Hertwig saw sexual appetite excited in a mare by vesical calculus. Exploration per rectum generally reveals the stone as a firm, hard substance; in mares it can be directly felt by passing the finger through the urethra. Gravel is rarer in the horse, though cases are on record where large quantities have been removed by operation.

Treatment. Internal medication is useless for dissolving the stone, and surgical removal alone can cure. Though it is certainly



FIG. 426.—Calculus passed spontaneously. Natural size. (Mr. McFarlane's case.)



FIG. 427.—Urethral obstruction removed by Mr. Mellis. Probably consisted of cystin.

easier to remove a stone from the urethra than from the bladder, neither operation is easy nor unattended with danger, especially in carnivora; herbivora bear operation much better.

Cutting for stone was first practised in man. In veterinary surgery it is said to have been introduced by Lafosse, who made the first attempt on a horse. Ercolani contends that even in the 14th century similar attempts had been made; but Bouley was probably the first successfully to employ the operation in the horse as a means of treatment.

Several methods formerly employed are now obsolete, such as cystotomia rectalis, in which the urinary bladder was incised through the lower wall of the rectum, and the stone removed through the rectum. Severe cystitis often resulted, and caused this method to be given up both in men and animals.

The bladder may also be reached through the lower portion of the abdominal wall, close to the pubis, a method which is known as cystotomia suprapubica, and is practised in human and canine surgery. In horses, as there is considerable danger of peritonitis, while the weight of the abdominal contents favours prolapse of the bowel, it is necessary to resort to a third method, namely, incision of the perineum (Cystotomia perinealis); or the urethra may be opened (urethrotomy) at one of various points in its course.

Urethral calculi in the horse are only exceptionally found close behind the glans. When in this position, however, they may be removed without much difficulty or bleeding, by the operator standing on the left side of the animal, drawing the penis forward by means of a cloth, or allowing an assistant to hold it, and then grasping the calculus with dressing forceps passed into the urethra. Sometimes strong pressure on the penis with the hand is sufficient, or the urethral orifice may be enlarged, and the calculus thus removed. Urine then generally flows away in large quantities, if not, a catheter must be passed, to discover whether other calculi remain in the urethra.

Landvatter removed from a gelding, by means of forceps, a calculus about $1\frac{1}{2}$ inches in length and $\frac{3}{4}$ inch thick, which lay in the terminal portion of the urethra. Two years later he took from the same animal a still larger one, which was fixed in the urethra 4 inches from the anus. Reichert grasped a calculus, lying $1\frac{1}{2}$ inches in front of the opening of the urethra, with a pair of dressing forceps and broke it down; fragments were afterwards passed with the urine. In a case seen by Rother, the calculus, which lay about $2\frac{1}{4}$ inches behind the glans, had caused ulceration and perforation of the urethra, in consequence of which urine had extensively infiltrated into the neighbouring tissues. The animal died from rupture of the bladder. Müller cured a horse apparently suffering from colic by removing two chalky concretions from the urethra; one from just behind the urethral orifice, the other about 4 inches further back. Concretions of inspissated smegma lying in the sub-urethral sinus may also cause dysuria in the horse.

Two cases of urinary calculi passed *per urethram* are related in *The Veterinarian* for 1896. A. M. McFarlane saw a horse apparently suffering from colic pass a stone weighing about 5 drachms, and of the size of the illustration (see Fig. 426). Thos. Mellis saw a three months old foal, which was violently straining to micturate and was evidently in great pain. On examination the body illustrated (Fig. 427) was found protruding from the meatus urinarius, and was without much difficulty removed. The figure is natural size, but Mr. Mellis states that nearly 1 inch was broken off in removal, and the total size was therefore much greater. This was probably a cystin calculus.

As a rule, in the horse, the calculus lies at the height of the ischial arch, where the urethra turns downwards and forwards. As casting an animal with distended bladder is open to danger, it is usual to operate in the standing position, the patient being controlled by twitches and its hind legs extended. To prevent accident it is best to place the animal in slings or stocks, so that it cannot lie down. Should a really dangerous horse require to be cast, every precaution must be taken, and a very thick straw bed provided. It is best to operate with the animal on the left side or back; the latter is perhaps preferable.

After plaiting the tail and cleansing the skin, a catheter or

whalebone staff is passed, and an incision 1 to 2 inches long made through the skin immediately over the urethra, that is, in the middle line of the body and over the point where the calculus can be felt. The incision of the wall of the urethra must be large enough to allow



FIG. 428.—Vaginal speculum.



FIG. 429.—Calculus spoon.

exit of the calculus, which may sometimes be removed by simply pressing upon it with the finger; if not, by employing forceps, or a small lithotomy spoon. Immediately the urethra is clear, urine flows away in large quantities; should not this occur the parts must be examined with a sound to discover if a second calculus be not present at a higher point. The urethral wound may be sutured with

catgut or silk, though this is not absolutely necessary, for healing readily occurs without sutures.

Operating in this way Russell removed from a cart horse a calculus $\frac{7}{8}$ inch long, $\frac{3}{4}$ inch broad, and $\frac{5}{8}$ inch thick. The surface was very rough. Three harelip sutures were inserted. Healing was rapid, the horse being sent home eight days after operation, and hardly any scar being visible six weeks later. There was no sign of stricture. (Cadiot and Dollar, "Clinical Veterinary Medicine and Surgery.")

Schirrmann removed a large bean-shaped calculus from the urethra of a gelding. It lay in the neighbourhood of the scrotum. The operation necessitated casting. Fröhner performed urethrotomy in a gelding and removed two calculi as large as a hen's egg.

After-treatment is very simple; the wound is either left completely to itself, after being powdered with iodoform, or is cleansed once or twice daily. Union occurs more quickly after suturing, but even without it is complete in two to three weeks.

Bad results seldom follow this operation, though healing by first intention is rare. Provided the incision be properly made and clean instruments used, infiltration of urine need not be feared, nor is suppuration probable, unless the parts were infected before operation.

Operation for **vesical calculus** may also be performed in the standing posture in quiet animals, the procedure being very similar to that already described. The recumbent position, however, is preferable, and many surgeons recommend operating with the animal on its left side, but the general consensus of opinion is in favour of the dorsal position; chloroform is necessary. The rectum must be emptied, the tail bandaged and the perineal region carefully cleansed and disinfected.

The instruments required are:—a grooved whalebone staff, or a catheter, convex bistoury, probe-pointed straight tenotome, lithotomy scoop, steel sound, grooved director, spoonbill forceps, Higginson's syringe, suture materials, and in case of need a urethral dilator and a lithotrite. Before use the instruments should be warmed and lubricated with sterilised olive oil. To facilitate incision of the urethral wall, the grooved staff, or the catheter should be passed along the urethra to beyond its ischial bend over which the opening is made vertically in the middle line or through the raphe on to the staff. The incision should have a length of $1\frac{1}{2}$ to $2\frac{1}{2}$ inches, extending upwards from the ischial border but not encroaching on the anal sphincter. Employing the convex bistoury, the skin, two perineal fascial layers, suspensory ligament of the penis, bulbo-cavernous muscle, erectile tissue, and urethral mucosa are divided and the

opening is enlarged with the probe-pointed knife inserted in the groove of the staff. Having opened the urethra, the staff may be withdrawn a few inches while the bladder is irrigated with a warm solution of boracic acid introduced by means of a Higginson's syringe. At this stage, if uncertainty exist as to whether or not the calculus is free, or fixed in the mucous membrane, the steel sound passed into the bladder and carefully manipulated will be found helpful. If the calculus is free, the forceps (Fig. 430) are now passed into the bladder, and attempts made to grasp the stone. As soon as contact



FIG. 430.
Calculus forceps.

with it is felt or heard, the forceps are opened and an effort made to seize the stone. The bladder being empty and more or less contracted, its wall is closely applied to the calculus and the forceps in closing are apt to engage a portion of the mucous membrane. A hand in the rectum is of much assistance in guiding the stone into the jaws of the forceps. Once grasped, the stone is held lightly, while the forceps are slowly rotated or gently pulled to make sure that the mucous membrane has not been included; and if no resistance is felt the forceps are firmly closed on the stone, which is drawn forward and removed.

In extracting the calculus the forceps should be half rotated, occasionally pulled laterally, and as progress is made pulled steadily towards the perineum.

The steel sound should be reinserted, or the bladder may be examined from the rectum, to make certain that no fragment, other calculus, or gravel is present, which would require removal or washing out, otherwise the bladder is again irrigated with warm boracic solution.

Suturing the wound is not absolutely necessary, though it somewhat hastens recovery; but if unskillfully performed, so that the urethra is left open while the skin is closed, infiltration of urine occurs and leads to abscess formation. For a short time urine escapes in part by the operation wound; but this soon closes, and only occasionally does urethral fistula result.

After-treatment consists in washing out the bladder occasionally with a lukewarm solution of boric acid or a 3 per cent. solution of protargol, by means of a rubber tube. If treatment must be left to laymen, a tube may be fixed in the urethra, otherwise

the practice should be condemned as favouring fistula formation and infection of the bladder. The tube must be cleansed and placed for a short time before insertion in the lotion to be injected.

Under anæsthesia the membranous urethra and neck of the bladder are capable of considerable dilatation, and sufficient space for the extraction of a large calculus can be made without danger by gradually opening the lithotomy forceps whilst still in the bladder; if not, the probe-pointed knife may be passed along the director towards the bladder and the mucous membrane of the superior wall, just behind the neck, incised on each side. If only a small calculus, or gravel, has to be removed, an attempt should be made to extract the stone without resorting to dilatation. In removing large stones, the neck of the bladder must sometimes be enlarged to such an extent as to admit the entire hand. After incision of the constrictor urethræ Möller once removed a cystic calculus weighing over 20 ounces.

The danger of operation increases with the size of the calculus, though stones of considerable magnitude may be safely removed, as shown by Möller extracting two calculi from the bladder of a nine-year-old gelding, one weighing $2\frac{1}{2}$ ounces and the other $20\frac{1}{4}$ ounces. The operation wound took three weeks to heal. In a second horse from which he took a stone weighing 20 ounces gangrenous cystitis with septic paraproctitis and peritonitis resulted, from which the animal died on the fifth day after operation.

Large calculi may be crushed, though the instruments intended for this purpose are not constructed for calculi of the above size. Calculi indeed often yield to powerful pressure from the forceps and fall to pieces; Bouley's forceps (Fig. 431) may be employed as a lithotrite. They have the advantage that they can be fixed after grasping the stone, thus rendering easier the extraction of large concretions. Bouley's instrument is useful, though in most cases the older calculus forceps are sufficient (Fig. 430). After crushing the stone, the pieces are removed with forceps and lithotomy spoon, or washed out by injecting warm boracic solution.



FIG. 431.—Bouley's calculus forceps.

In mares, vesical calculi may generally be removed without incision; the urethra can be sufficiently dilated to admit a small hand, and calculi the size of hens' eggs have thus been removed.



FIG. 432.—Vesical calculus composed of phosphate and oxalate of lime. Weight, $3\frac{3}{8}$ ounces; circumference, $7\frac{1}{4}$ inches. (Chinniah's case.)

Forceps are used, and the urethra slowly dilated. A hand in the rectum assists in securing the stone, which is withdrawn by steady traction on the forceps. Möller removed by this method from the

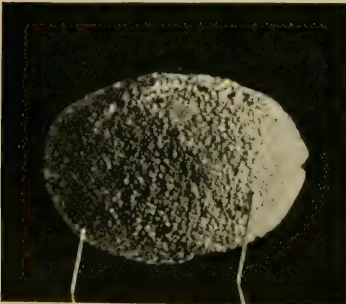


FIG. 433.—Cystic calculus removed by V. Major Walker.

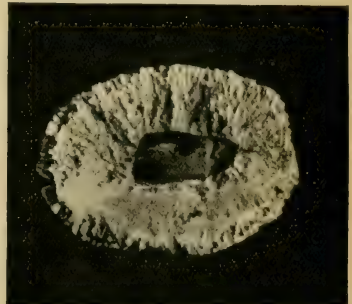


FIG. 434.—Section of same calculus.

bladder of a mare a stone weighing nearly $2\frac{1}{4}$ ozs. Hertwig divided the urethra laterally, Kutzner the upper wall; Fehsenmeir, after dividing the urethra for the space of 2 inches in an upward direction, withdrew by hand a stone weighing 7 ozs. Krämer removed one

of $15\frac{1}{2}$ ozs.; the urethra was dilated throughout, so that Krämer was able to remove the stone by hand. Recovery occurred in twenty-eight days.

The stone illustrated, weighing $3\frac{3}{8}$ ozs., and measuring $7\frac{1}{4}$ inches in circumference, was removed by A. Chinniah, of Ceylon. It was not spherical, but convex on both surfaces, and was apparently composed, outwardly of phosphate, and inwardly of oxalate of lime. The final results of operation were not reported, though the animal was said to be doing well.

Walker (A. V. D.) removed from a gelding an oxalate of lime calculus weighing $7\frac{1}{4}$ ozs., with a nucleus, consisting of blood clot (see Figs. 433 and 434). Instruments failed to grasp or crush the stone, so the constrictor urethræ was incised on both sides, the hand introduced into the bladder and the stone, which was of oval section and measured 3 inches in diameter, was removed. The urethral wound was twice sutured, but the stitches tore out on each occasion; nevertheless the parts healed so far that the horse returned to duty in two months, and three months later urine ceased altogether to be passed by the fistula. (*The Veterinarian*, 1898.)

(2.) URETHRAL CALCULI IN RUMINANTS.

Of all animals the bull or ox suffers most from calculi. Formed in the bladder, they enter the urethra during urination, and partly on account of its comparatively narrow lumen, partly of its peculiar course, remain fast (Fig. 435).

The pelvic portion resembles that in other animals and has a width of $\frac{3}{16}$ to $\frac{6}{16}$ of an inch, but in the external portion the passage contracts to $\frac{1}{8}$ inch, and at its orifice even to $\frac{1}{16}$. In the neighbourhood of the scrotum it makes with the penis the so-called "S" inflexion. At the first bend near the scrotum (*h*), the penis turns once more backwards making about 3 inches behind and over the posterior surface of the scrotum a second bend (*i*); at the height of the latter the retractor penis (*l*), which is very strong in cattle, becomes attached. The sinuous course and slight diameter of the urethra explain why even small calculi or concretions, weighing only a few grains and not exceeding the size of a pea, may remain fixed in the urethra and obstruct it. The stones are usually lodged in the first bend (*h*), less frequently in the second or near the end of the organ.

Diagnosis. Urethral calculi first attract notice by the difficulty which exists in passing urine. The animal is fretful, stamps with the hind feet and moves to and fro, lifts the tail and makes frequent short side movements with the root of it; it lies down, but immediately rises again, and strikes with the hind feet towards the body.

In oxen slight symptoms of colic should always arouse suspicion of urinary calculus and lead to examination of the bladder and urethra. The bladder and sometimes the upper portions of the urethra are found excessively distended, and the latter may show pulsative movements as the animal strains whilst a few drops of urine are sometimes passed. Passing the finger along the course of the urethra causes the animal pain and uneasiness at the seat of obstruction, though the stones can seldom be directly felt. Retention of urine for twelve to twenty-four hours may result in rupture of the bladder and death after a few days. After rupture the pain diminishes, the

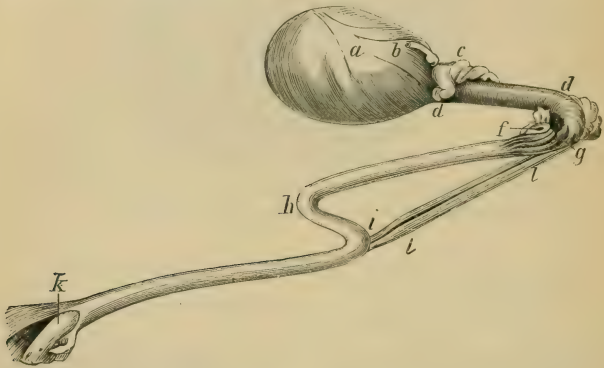


FIG. 435.—Course of the urethra in the ox. (After Hering.)

a, Urinary bladder ; *b*, ureter, cut off ; *c*, vesiculæ seminales ; *d*, pelvic portion of urethra ; *f*, commencement of the corpus cavernosum of the penis ; *g*, ischial curve of the urethra ; *h*, first bend ; *i*, second bend ; *k*, anterior extremity of the penis ; *l*, retractor penis muscle.

animals may even begin to feed again, but tympanites soon sets in, and death takes place with symptoms of peritonitis and uræmia (frequent pulse, rigors and giddiness). Cases are reported where oxen have lived for some weeks after rupture of the bladder. Stöhr mentions an ox which lived six weeks, and Jacobi states having seen recovery after rupture, but as a rule animals in this condition are at once slaughtered, to avoid injury to the flesh, which acquires an unpleasant smell from resorption of urine from the abdominal cavity. Franck therefore recommends removing the urine by a trocar passed through the floor of the abdomen.

In oxen it is important to operate early, and, on account of the peculiar course of the urethra, one method alone, viz., urethrotomy, is available. With few exceptions the calculus is found at the first

curve, and can be reached most directly from the anterior surface of the scrotum. As, however, it is less convenient to operate here, most practitioners make the incision behind, and about a hand's-breadth above the scrotum. For this operation the animal should be cautiously cast and laid on the left side though quiet oxen may be operated on standing. The right hind foot is drawn forward with a cord, exposing the field of operation.

After making sure by rectal examination that the bladder is not ruptured, and having once more carefully determined the position of the concretions by palpation, the skin is incised for 2 to 3 inches in the direction of the urethra, either at the point where the greater sensitiveness or hardness of the swelling indicates the obstruction to be, or a hand's-breadth behind and above the scrotum. The retractor penis muscle, which is much more developed in the ox than in the horse, is then divided to the same extent. The urethra can then be felt, and if one operates at the point where the calculi are fixed the latter may be detected within it. After incising the corpus cavernosum, and the urethra itself, the calculi are easily removed.

Where, however, the calculi are situated in the first bend of the urethra (*h*) the retractor penis is divided, and an attempt made to draw forward the penis with the hand; the bulbo-cavernosus muscle and urethra are then cut through, and the stones removed by pressure with the fingers, or if necessary, by means of forceps. When single, the stone sometimes becomes so firmly fixed in the swollen mucous membrane that even the knife must be employed to free it. The cut in the urethra should be as small as possible, to facilitate healing and prevent stricture. Should the stone be the sole obstruction to passage of urine, an immediate discharge occurs on its removal, partly through the operation wound and partly from the orifice of the urethra, but in any case it is necessary to examine the lower portion of the urethra with a catheter, to discover whether other stones are present and require removal. In oxen concretions often occur in hundreds, resembling large tapioca grains. The urethral wound need not be sutured, though Reichle and Pflug recommend inserting a few silk sutures to assist healing; Ciani suggests dividing the urethra from the side, and closing it with close-set sutures, to prevent infiltration of urine. The penis is then allowed to return to its natural position. To prevent infiltration the outer wound is not sutured, but it often occurs in spite of this precaution. Esser, therefore, provides for escape of urine and wound discharges by passing a drainage-tube forwards, and allowing its anterior end to project

in front of the scrotum. He says this prevents infiltration of urine, which not only checks healing, but constitutes a grave danger to the animal's general health. The operation wound heals in about fourteen days.

When the calculus cannot be discovered, Ciani recommends completely dividing the urethra above the obstruction, producing fistula, to allow passage of urine, and fattening the animal.

Urethrotomy in front of the scrotum.

As already remarked, the calculus almost always lies in the first bend of the urethra, just above the scrotum. This position is inconvenient for operation, and is not often selected in Germany; it seems to be more in use in France. According to Peuch and Toussaint, the animal is laid on its left side, the right hind foot drawn towards the shoulder, and the operator draws the penis forward so as to extend the "S"-shaped bend. Should the stone now be felt, a longitudinal incision is made in the urethra and the calculus removed with forceps or a spoon. If not, the hair is cut away in front of the scrotum, a cross fold of skin pinched up and divided, exposing the penis. The index finger of the left hand is passed into the opening, the penis grasped with the bent finger and drawn out through the wound. The rest of the operation is as above. Dupont divides the urethra immediately after cutting through the skin. If, after removing the stone, no considerable quantity of urine is discharged, the urethra must be explored, and, if necessary, the operation repeated again at a higher point. Bouley thinks infiltration of urine need scarcely be feared, and if it should appear, can be cured by making deep incisions; abscesses, when occurring, are similarly treated.

Urethrotomy in the ischial region.

On account of the considerable diameter of the urethra, calculi seldom become fixed at this point, and operation is usually performed at the ischial arch only to give relief more rapidly and remove the imminent danger of rupture of the bladder. Operation here is also easier for the unpractised. After providing an exit for the urine, the concretions, which lie at a lower point, are allowed to remain. The operation is, therefore, most useful in animals nearly ready for slaughter, though it may be replaced by puncture of the bladder (see section hereafter, "Puncture of the Bladder").

This method may also be resorted to if the stone cannot be found, or if found, cannot be removed, or if such changes have occurred in the urethra as are likely to prevent passage of urine.

The general procedure and after-treatment are similar to those in the horse. If the animal is not destined for early slaughter a tube

should be fastened in the urethra to keep the wound open, but this measure is only of temporary benefit on account of inflammatory swelling setting in and preventing discharge of urine. Dupont therefore recommends, in the event of a calculus being found at this point, to thrust it back into the bladder, thus obviating the necessity for such a large urethral wound.

As relapses are not uncommon it is usually advisable to fatten the animal for slaughter as soon as possible.

Bader, who performed one hundred lithotomies in the ox, almost always found the calculus in the first (lower) curve of the urethra. Most of the animals were in the first or second year of life, a few in the third, and only one in the fourth. In 24 out of 25 cases, Deisinger found the stone in the lower curve of the urethra. Diani states having seen 300 cases, and having found the stone in the upper curve, or between it and the lower one, in 98 per cent. of these. In 2 it lay in the pelvic portion, and in 5 or 6 near the glans.

Urethrotomy in the sheep.

The ram's narrow urethra lies embedded for the most part in fatty tissues, and is therefore still more difficult to find than that of the ox. Calculi and deposits are not common in sheep, and when occurring are usually found close behind the opening of the urethra, which extends beyond the penis, is free and curved, forming the vermiform appendix. Dammann has described several cases of the kind.

The symptoms are similar to those in cattle. Retention of urine renders the animals restless, they stand with the back arched straining to pass urine, and examination per anum shows the bladder to be greatly distended. By closing the nostrils with the hand a healthy sheep can be caused to pass urine, but here the attempt is unsuccessful, or only a few drops are passed.

According to Peuch, it is usual in France, as in Germany, to remove the appendix of the urethra in cases where calculi or concretions cause retention of urine. The same is recommended in England; Read saw a case where 11 to 12 pints of urine were afterwards passed.

If the obstruction lie further back, Peuch recommends, in valuable animals, passing a catheter or sound. The sheep is placed on its back and the penis drawn forward out of the prepuce. A flexible metallic sound is then passed into the urethra, which has previously been laid open transversely close behind its free end. It is said to be thus possible to displace the sediment and effect an exit for the urine.

Others recommend laying open the urethra at the ischial arch,

a method which also admits of the removal of vesical concretions. Luthens opened the urethra of a ram at the "S" bend as is done in the ox; the animal, however, died from further formation of calculi.

Complications of urethrotomy in herbivora—

(1) Unless the bladder is ruptured before or during operation, an abundant discharge of urine follows removal of the calculus. Sometimes, however, the detrusor urinæ having been greatly over-extended and failing to contract, the bladder appears paralysed. In such cases, in oxen, the hand should be introduced into the rectum and attempts made to empty the bladder by exercising slow and steady pressure upon it. Meisel recommends moving the animals, but altogether considers the condition very grave.

(2) A second unfavourable complication consists in the formation of stricture of the urethra at the point of operation, though this only occurs if the animal lives for a considerable time afterwards, which is seldom the case in oxen. Relapse being probable, the animal should be immediately prepared for slaughter. Räber suggests keeping a metal tube in the urethra, but this is of no permanent service, the irritation produced causing fresh stenosis.

(3) Abscesses which form at the point of operation are laid open and treated on general principles.

Cystic calculi are rare in ruminants, and are generally found quite accidentally after slaughter, not having caused any disturbance during life. They seldom produce noticeable symptoms, as the average life of oxen is too short to allow of their attaining any considerable proportions. But all the necessary conditions for their production exist, as is shown by the frequent occurrence of urethral calculi. Hermann found in the bladder and urethra of a three months calf calculi of a collective weight of 5 drachms.

The symptoms in the ox are similar to those in the horse. In operating, the same general principles are observed in both animals.

(3.) URINARY CALCULI IN SWINE.

In swine this disease is of less interest. Serious cases are best slaughtered. As in oxen, calculi and concretions are sometimes found in the bladder after death; Schell met with a collection of white earthy concretions weighing 13 drachms in the urinary bladder of an eighteen months pig that had always appeared healthy.

(4.) URINARY CALCULI IN THE DOG.

The urethral calculi not infrequent in old dogs are usually formed in the bladder. They almost always become fixed in the gutter of the os penis or close behind it. Straining to pass urine, passage of a few drops, uneasiness, distension of the bladder, &c., sufficiently indicate the nature of the condition.

A metal catheter, which is easily introduced into the urethra, will at once reveal the presence of the calculus and its position. In this examination the dog is laid on its back, with its left side towards the operator. The prepuce, which should be grasped about an inch behind its termination, is then thrust back with the fore-finger and thumb behind the corona glandis, the latter firmly pressed upon, and the penis thus caused to protrude. The catheter is then introduced into the opening of the urethra, which is easily seen, and passed onwards until checked by contact with the calculus, readily recognised by its hardness. By now removing the left hand from the prepuce, the end of the catheter and the stone may at once be felt below the skin.

In spite of this the operation offers greater difficulties than in other animals, is often followed by stricture, and not infrequently proves fatal. It has therefore been recommended, when possible, to thrust the stone back into the bladder, which may sometimes be effected with the help of an elastic catheter; but if, in consequence of the rough nature of the stone and the already existing swelling of the urethral mucous membrane, this prove impossible, early operation alone offers a chance of saving life, for rupture of the bladder in dogs leads to death in twenty-four to forty-eight hours, and is the more to be feared the more completely the passage of urine appears to be interfered with.

Urethrotomy is carried out in dogs in the above described dorsal position. A catheter or sound is passed into the urethra and held by an assistant; the skin is then incised for a length of $\frac{3}{4}$ to 1 inch immediately over the stone, and a second incision made exposing the stone. The difficulties only begin at this point. As the gutter in the os penis is narrower below, and forms a kind of tube split along its inferior margin, it is often impossible to remove the stone, even when completely exposed. It is often necessary to employ a powerful but narrow pair of forceps, so as first to break down the calculus and then to remove the fragments from the swollen urethra, a proceeding often entailing injury to the latter. Several more calculi may be lodged behind the first and cause great difficulty in removal;

and therefore, if urine is not at once voided in considerable quantities after removing the stone, the urethra should be examined with a sound, or elastic catheter.

More serious embarrassment is caused by the infiltration of urine, which often happens in dogs, and is almost always followed by suppurative inflammation with sloughing. Possibly the acid reaction of the urine in carnivora plays an important part in effecting this, or it may be caused by decomposition products resulting from alkaline fermentation of the urine. Simon has noted that though acid human urine injected into the subcutis produces no inflammatory change, it is quite otherwise when alkaline fermentation has set in. Whatever the cause, the fact remains that infiltration of urine in the dog nearly always causes inflammation, which tends to assume a necrotic character. In such cases good results often follow from vegetable diet and the free administration of alkalis. Repeated washing of the wound with alkaline lotions like 5 to 10 per cent. sod. bicarb., or powdering with a mixture of sod. bicarb. and iodoform, also appears useful. Should these complications be safely escaped, cicatricial contraction of the urethra occurs after some time, and greatly impedes the discharge of urine. As a rule, operation in carnivora for urethral calculus must be classed amongst the least thankful exercises of the healing art.

Of cystic calculi in the dog the same may be said as of cystic calculi in ruminants and swine. In spite of an extended experience in canine practice, Möller never found opportunity to carry out lithotomy in these animals, though he repeatedly met with cystic calculi in making post-mortem examination. Hendrickx and Liénaux successfully removed a cystic calculus in the dog by *laparo-cystotomy*; Malzeff and others have also performed the operation.

Malzeff anaesthetises the dog, which is then laid on its back. The bladder having been emptied, washed out with 2 per cent. boric solution, and the seat of operation thoroughly disinfected, an incision, 2 inches long, is made over the linea alba. The incision commences at the symphysis pubis and is carried down to the peritoneum, the penis meanwhile being pushed towards the left side. The peritoneum is next opened, and (the hands having been carefully disinfected) the urinary bladder is sought for by introducing the forefinger. When discovered it is grasped with forceps, drawn forward into the wound, and incised for a short distance to permit the stone to be withdrawn. Bleeding is slight. The wound in the bladder is next closed with boiled or carbolised silk, that in the abdominal coats cleansed with 2½ per cent. carbolic solution, powdered with iodoform, and brought together with button sutures. A dressing is useless, and even hurtful, as it makes the patient restless. Eleven cases out of twelve recovered. Cadiot, after shaving and disinfecting the operative area, covers it with a bandage provided with an opening, through

which he incises the abdominal wall at the side of the sheath parallel with the linea alba in the male, or through the white line in the female. The incision extends from the umbilicus to near the os pubis. Hæmorrhage having been stopped and the peritoneum opened, the bladder is drawn into the wound and fixed with a sterilised compress. An incision $\frac{3}{4}$ to 1 inch long is then made through the fundus or superior wall of the bladder, and the calculus grasped with forceps is extracted. After washing out the bladder with boracic solution, the wound is closed by Lembert's sutures, or by superposed stitches. The suture line is mopped with alcohol or strong solution of carbolic acid and the bladder is released. The abdominal wound is sutured in layers, and finally the seam is dried and covered with iodoform-collodion. Rubay claims to have opened the kidney without penetrating the peritoneal sac, removed the calculi, and washed out the pelvis of the kidney and returned the organ to its position.

III.—PUNCTURE OF THE BLADDER (PUNCTIO VESICÆ).

WHEN the discharge of urine by the natural passage is hindered, the urinary bladder becomes enormously distended, and puncture by trocar is resorted to to prevent rupture. The operation was first practised in dysuria in man, and is still employed, particularly in cases of enlargement of the prostate. The trocar used for the horse is an enlarged copy of that constructed for the above purpose by Flourant (Fig. 436). Pilger described the operation more exactly, and later it was frequently employed in oxen which suffered from urethral calculi. Before attempting it, the diagnosis of over-distended bladder must be verified by rectal examination. In the horse the distended bladder extends forwards and downwards, that is, towards the abdominal cavity. In oxen and bulls the extension takes place more towards the sides. Even in the horse, however, the bladder does not reach the lower wall of the abdomen; this condition is only seen in swine and carnivora, in which the bladder, when filled, lies to a great extent in the abdominal cavity. It need scarcely be said that, before making the attempt, all simpler means, as, for instance, the use of the catheter, should have been tried.

The bladder may be reached from different points if Flourant's form of trocar, which is moderately bent (Fig. 436), be employed. Three different methods of puncture are distinguished.

(1) *Punctio vesicæ suprapubica* is impracticable in herbivora, because in them the lower part of the bladder is not attached to the wall of the abdomen, and in the horse and ox the bladder would be only reached through the peritoneal cavity. In swine and dogs it can, however, be approached from the lower abdominal wall, and this path is to be preferred because the more convenient method of operation through the rectum employed in larger animals

is here attended with difficulty. Hering, who recommends this operation for dogs, places the animal on its side, and, after making an incision through the skin, passes a thin trocar into "the tensest portion of the swelling in the lower region of the flank." In man the puncture is made close to the *linea alba*, and the same procedure has been recommended in dogs. Hering states having completely cured a dog by his method, though he does not say what caused the difficulty in urination.

(2) In large animals puncture is effected from the rectum (*punctio rectalis*).

This is the easiest method and that usually followed when it is desired, as often happens in oxen, promptly to remove the danger of ruptured bladder, and it is intended to slaughter the animal in a short time. The cannula, with the trocar drawn back (covered) is introduced into the rectum, and directed as nearly as possible perpendicularly to the surface of the bladder. It is well not to go much beyond the neck of the bladder, but rather to pierce it close behind the neck, so as to avoid opening the peritoneal sac.

(3) *Punctio perinealis* deserves preference in large animals unless when destined for early slaughter. Inflammation of the urinary bladder is less likely than in *punctio rectalis*, where it readily occurs in consequence of infection from the rectum. The skin is incised close below the anus and somewhat to the side of the urethra, and efforts are made to penetrate thence as far as the neck of the bladder by working with the fingers, assisted when needful with knife and scissors. As soon as the distended urinary bladder is felt, a straight trocar with the point covered is introduced, placed on the bladder and the stilette pressed forwards. On withdrawal, urine is discharged through the cannula, which is slowly thrust forward so as to

follow the movement of the collapsing walls of the bladder. Should a single evacuation suffice, the trocar is at once removed; it is not necessary to suture the skin wound. Hering recommends, after making the cutaneous incision, to thrust the trocar directly forwards in the direction of the urethra, as far as the bladder without dividing the connective tissue. When considerably distended, the bladder can scarcely be missed. Should the prostate or vesiculæ seminales be



FIG. 436.
Flourant's trocar.

injured little harm results especially in castrated animals. On the other hand, however, there is no reason against providing, as far as possible, a safe passage for the trocar. If it is desired that the animal shall live for a considerable time after operation, this method certainly deserves preference, as, in the event of a repetition of the operation becoming necessary, it will be much easier.

The cannula may remain in position for one to two days; in oxen intended for slaughter this is to be recommended, and an additional advantage is that the tube may here be more easily fixed in position than in the rectal operation.

In quiet animals the above operations may be performed standing, by extending the hind feet and applying a twitch. Rychner recommends the dorsal position, because it allows the bladder to be still more easily discovered from the rectum. It has already been remarked that where the bladder is much distended, casting must be effected cautiously.

IV.—INJURIES, INFLAMMATION AND STRICTURES OF THE URETHRA.

SAVE by operation, the urethra is seldom wounded. Adam describes a case of injury in the horse by an iron hook. Healing was difficult. Fauchs saw a severe case in a horse that had fallen in front of a tramway car. The urethra was almost completely torn out of the penis by a hook: a small portion remained hanging to the glans; the rest was only connected with the bladder. About 16 inches was cut away and the wound disinfected. Some hours later bleeding occurred from the corpus cavernosum, but was checked by ligature, and though severe swelling occurred it disappeared in eight days. Recovery was sufficiently advanced in four weeks for the horse to return to work. The urethra opened somewhat below the perineum.

Inflammation of the urethra may be caused by foreign bodies entering it accidentally, or being introduced by way of treatment.

Should foreign bodies like awns of wheat obtain access, the minute spines they possess cause them to produce injuries of the mucous membrane and inflammation. Specific conditions like gonorrhœa of man have seldom been recognised in animals, if we except dogs and bulls, which occasionally suffer from chronic urethral catarrh. Many cases are really only purulent preputial catarrh (see "Inflammation of the Prepuce in Carnivora").

Stricture of the urethra is commonest after operations like

urethrotomy and amputation of the penis, but it may also result from accidental injury.

Perforating wounds of the urethra are recognised by urine escaping through them during micturition. They are often associated with symptoms of infiltration of urine, such as inflammation, severe swelling, and a tendency to necrosis. Such a complication is most to be feared when the wound in the mucous membrane is greater than that in the skin, or when the latter is not divided at all, as in bruises.

Swelling of the mucous membrane of the urethra consequent on inflammation produces symptoms like those of urethral calculus. In oxen the urethra is said to be sometimes ruptured by the passage of urethral calculi.

Foreign bodies in the urethra produce a like train of symptoms. Bluhm describes the case of a horse which suffered from colic and retention of urine, and allowed the penis to protrude from the sheath. Careful examination discovered in the urethra an oat-head 4 inches in length with awns.

Strictures are recognised by slowly increasing difficulty in urination. The stream of urine gradually becomes smaller as time elapses, the act is more and more protracted; finally fluid can only be discharged in drops. Passage of the catheter reveals the position and extent of the stricture. The symptoms produced by urethral calculi generally appear suddenly.

Purulent catarrh of the urethral mucous membrane in dogs can be recognised by laying the animal on its back, drawing forward the penis (see "Urinary Calculi in the Dog"), and passing a sound or a finger over it with moderate pressure from the corona glandis to the opening of the urethra, when, if urethritis exist, a purulent secretion will be discharged.

The prognosis is very varied. In injuries, it depends on whether urination is impeded, and whether infiltration of urine exists or is to be expected. Impeded urination may be due either to inflammatory swelling or stricture. The less the inflammation and infiltration of urine, the more favourable the prognosis. Injuries of the urethra in carnivora are graver than in herbivora, because they readily lead to gangrenous cellulitis.

Intra-urethral injuries, caused by careless management of the catheter, are seldom dangerous, for the wound opens forwards and hence is not favourable to infiltration of urine. On the other hand injuries by foreign bodies easily induce retention of urine and inflammation in the mucous membrane, with the formation of

urethral calculi, because such bodies carry with them organisms likely to determine decomposition of urine. Stricture is always grave, especially in horses, as it becomes aggravated with time; the greater the interference with urination, the greater the danger.

Treatment. The chief indications are to prevent retention and infiltration of urine, and to assist union. The more regularly and rapidly healing proceeds, the less the chance of cicatricial contraction and stricture formation. The wound is treated on general principles, and protected as far as possible from discharge of urine. Clean-cut wounds of the mucous membrane may be brought together with catgut or silk, and in herbivora sometimes heal by first intention. In carnivora it is still more important to suture the mucous membrane, in order to prevent infiltration. For the same reason the skin wound is best left open. Under these circumstances healing by first intention occurs in exceptionally favourable cases. If not, the skin wound, when not already larger than that in the mucous membrane, may be increased in size. In carnivora the injured spot should be washed every hour or two with an alkaline fluid (5 per cent. bicarbonate of soda), or powdered with iodoform and bicarbonate of soda (equal parts), and vegetable diet enforced until the wound is healed. The greatest care is necessary during the first few days; after granulations have formed, infiltration of urine is less likely to occur. Injuries produced by the catheter must also receive close attention. If during the first twenty-four hours great swelling and retention of urine result, urethrotomy or puncture of the bladder may become necessary to prevent rupture. Foreign bodies should be removed as soon as possible from the urethra, and the injury they may have caused treated according to existing circumstances.

When urine has infiltrated the tissues, careful provision must be made for its exit, by inserting drainage-tubes. Scarification may be of assistance.

Though strictures of the urethra may be dilated by passing the catheter or a bougie, and urination thus assisted, the effect is seldom permanent, and the method not of much practical value. In large animals it may temporarily relieve the difficulty, but new strictures soon form. Strictures near the free end of the urethra may sometimes be cured by freely laying them open.

Urethral fistula is caused by an injury healing incompletely, and leaving a little opening in the wall of the urethra, through which urine is from time to time discharged. It may sometimes be closed by applying the actual cautery; but often it gives much trouble to the practitioner, and ends by producing stricture of the urethra.

Moussu saw such cases in dogs after injuries to the urethra. Fröhner improved the appearance of a horse suffering from urethral fistula by performing urethrotomy at a point above the fistula where there had been a dilatation of the canal. Urine was afterwards discharged by the artificial opening.

V.—PARALYSIS OF THE URINARY BLADDER (CYSTOPLEGIA). CATHETERISM.

LONG-CONTINUED retention of urine, due sometimes to urethral calculus, causes over-distension of the bladder, paralysis of the detrusor urinæ, and inability to eject the urine.

Paralysis of the sphincter vesicæ produces involuntary discharge of urine (enuresis, incontinentia urinæ). Not infrequently retention and involuntary discharge exist together, *e.g.*, in puerperal apoplexy, influenza, &c. In diseased conditions, like post-partum paralysis, hæmoglobinuria, in diseases of the brain and spinal cord, and fractures of the dorsal and sacral vertebræ, and after difficult parturition, paralysis of the bladder may occur, and is sometimes associated with paralysis of the tail and paraplegia. Calculi and gravel may also produce paralysis of the urinary bladder.

Symptoms. When the detrusor is alone paralysed, the bladder gradually fills, and urine is discharged in small quantities (ischuria). If paralysis of the sphincter is also present, involuntary discharge occurs, the bladder overflows like an over-filled vessel, and the condition is described as ischuria paradoxa. The bladder can then be emptied by pressure from the rectum, or by contraction of the abdominal muscles, as happens during defæcation. At each act a variable quantity of urine is discharged. When the sphincter is completely paralysed urine also flows away in an uninterrupted stream, even when the bladder is incompletely filled (enuresis); nevertheless, in male animals the bladder always fills to a certain extent.

The prognosis depends on the active cause. In general it is the more unfavourable the longer the condition has existed without visible improvement.

Treatment. At first an attempt should be made to remove the cause. Strychnine, cantharides, &c., may be given internally; when, in consequence of paralysis of the detrusor, the bladder is greatly distended, it may be emptied by pressure through the rectum; or should this fail, by the catheter.

The use of the catheter (catheterisation) calls for two precautions :

the urethra must not be injured internally, nor must infective or decomposing material be introduced into it. Failure to observe the latter precaution may result in decomposition of the urine, inflammation of the bladder (cystitis), or even fatal pyelonephritis, on account of the inflammatory processes spreading as far as the pelvis of the kidney.

In Germany elastic rubber tubes are generally employed; the outer opening is somewhat dilated, whilst the opposite end possesses one or two lateral openings (eyes), by which the urine may enter the catheter. A suitable stilette serves to assist the introduction and cleansing of the instrument.

For large male animals one large catheter generally suffices;

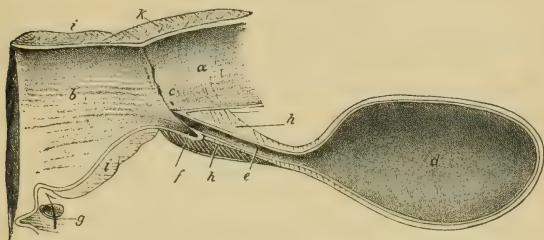


FIG. 437.—Median section of the bladder, urethra, vagina, and vulva of a cow.
a, Vagina; b, vulva; d, bladder; e, urethra; f, blind sac below urethra; g, clitoris.

for dogs, flexible and metal catheters of varying calibre must be kept. For mares and cows a slightly bent tube with a well-rounded end is used, though in case of need the index or middle finger may replace the catheter. The introduction of the catheter is seldom difficult in these animals, if it be borne in mind that the outer opening of the urethra lies on the lower wall of the vagina, over which the instrument is allowed to glide forwards until it enters the urethra. For cows Imminger uses a special instrument about 13 inches in length and $\frac{3}{16}$ inch in diameter, with a pointed end and a small round head; he also employs a metal catheter 12 inches long and $\frac{1}{4}$ inch thick, slightly bent towards the rounded point, which is $\frac{3}{4}$ inch long. Before passing the catheter, the cow's head is firmly tied to a ring or the animal is thrust against a wall. The hand is oiled and passed into the vagina, where the opening of the urethra is soon discovered and is slightly dilated by passing the forefinger into it. The catheter is then passed in and slipped beneath the finger into the urethra and so into the bladder. As, in young animals, the forefinger can

scarcely be introduced into the urethra itself, the fore and middle fingers are passed as far as the opening and the catheter introduced between them. A blind sac (Fig. 437 f) of varying size exists behind or below the opening of the urethra in cows, and sometimes renders the passage of the catheter difficult, the point of the instrument readily passing into the sac. In stallions and geldings the operator stands at the side of the abdomen on the animal's left, and draws the penis forwards out of the sheath. In order to grasp it more firmly a cloth is passed round the penis, and the catheter is then introduced. The instrument must, however, have been previously carefully cleansed to prevent the introduction of organisms into the bladder, and, to allow of its easy passage, the surface should be smeared with vaseline. In the anterior sections of the urethra the catheter glides easily forward under slow, steady pressure. The first difficulty is on passing the bend of the urethra at the ischial arch. Here an assistant must direct the point of the catheter towards the bladder by pressing on it, whilst the operator thrusts the instrument cautiously on, and gradually retracts the stylette. Violent movements at this stage are liable to injure the urethra, and must be strictly avoided.

Immediately the end of the catheter has passed this point it again glides easily forwards, and finally attains the neck of the bladder, which seldom opposes any resistance to its entrance. The stylette is then withdrawn and the urine allowed to escape.

In bulls and oxen only the forward end of the urethra as far as the "S"-shaped curve can be catheterised, and even this seldom becomes necessary. The same is true of rams, though in them the entrance is rendered still more difficult by the vermiform appendix. In case of need, the appendix may be cut off or the urethra incised behind this point (see "Urethrotomy in Ruminants").

Catheterisation is easiest in the dog. The animal is placed on a table in the dorsal position, with the left side towards the operator. The penis is then exposed by the method described under "Urinary Calculi in the Dog," and the catheter, previously carefully prepared, passed into the urethra. To prevent injuring the canal at its curve over the ischial arch, the instrument is passed as far as this point, and the stylette then drawn back at the same rate as the catheter advances; when the bladder is reached, the stylette is removed entirely.

By means of the catheter not only can decomposed urine, &c., be removed, but fluids may, if necessary, be introduced into the bladder and its mucous membrane directly treated. Baertz, in a case of strangury, injected infusion of belladonna with good results.

Grintzer states having cured contraction of the neck of the bladder which impeded catheterisation in a horse by clysters of chloral hydrate, renewed at intervals of a quarter of an hour.

VI.—INFLAMMATION OF THE URINARY BLADDER (CYSTITIS).

INFLAMMATION of the mucous membrane of the urinary bladder, when not arising from infection, results from decomposition of the urine (alkaline fermentation), and irritation produced by products of such decomposition; or from mechanical lesions produced by hard bodies like cystic calculi. In females infective processes of the uterus and vagina may extend to the bladder, especially soon after parturition. Röder saw such a case in the cow. Frequently cystitis is due to infection conveyed by the catheter. Finally, irritant substances, cantharides, oil of turpentine, and the like, excreted in the urine, may cause inflammation of the cystic mucous membrane.

Inflammation of the outer surface of the bladder, that is, of the serosa covering it (pericystitis), sometimes occurs as a diffuse peritonitis after castration and similar causes. It may, however, appear locally in consequence of chronic inflammation spreading from the uterus or rectum.

In a horse described by Oeben, which had suffered for four days from colic, and had died after passing large quantities of fæces and exhibiting continuous straining, the wall of the urinary bladder was found to be nearly 2 inches thick, the walls of the rectum and of the iliac arteries were as thick as a man's finger, but showed no diminution of their lumen; probably the inflammatory process had started from the rectum.

Siedamgrotzky was able, by washing out the bladder, to remove a great quantity of sediment from a horse which had suffered from enuresis paralytica, and which, though continually straining to pass urine, could only eject small quantities in jerks, whilst at other times discharge occurred involuntarily. The horse, however, died, and on post-mortem was found to have suffered from purulent fibrinous cystitis, pyelonephritis, and peritonitis. Friedberger reports a case of chronic hæmorrhagic purulent cystitis in the horse, caused by cystic calculus.

Symptoms. Repeated attempts to urinate and the passage of small quantities of unhealthy urine point to the presence of the disease. The animals often stretch out as if about to micturate; male animals may exhibit erections, and females contraction of the vagina. Pressure through the rectum or vagina on the almost empty

bladder causes acute pain. The urine discharged is turbid, and shows on microscopical examination much cystic epithelium, blood, pus corpuscles, flakes of mucous membrane, and not infrequently crystals of triple phosphate in the well-known coffin-lid shaped form. In carnivora micturition is difficult and painful; the urine contains mucus, albumin, epithelial debris, white corpuscles and bacteria, and gives an alkaline reaction. There is great depression with fever and constipation, and the appetite is diminished or suppressed.

Pus in any considerable quantity produces a yellow sediment, whilst in fibrinous cystitis false membranes are discharged with the urine. Infection of the bladder is usually associated with fever, the intensity of which indicates the nature and significance of the disease. Cystic calculi are often indicated by discharges of blood, especially after work (see "Urinary Calculi in the Horse").

Chronic pericystitis seldom produces marked symptoms, but leads to gradual thickening of the bladder wall; and post-mortem shows a condition greatly resembling those hypertrophic processes resulting from long-standing obstruction to urination (dysuria), which are associated with abnormal distension of the bladder itself. Fünfstück, when making the post-mortem of a goat, found the bladder of enormous size and containing 52 pints of fluid.

The course of this disease varies; for whilst purulent fibrinous cystitis, either directly or in consequence of complication with pyelonephritis, soon proves fatal, pericystitis and chronic inflammation, caused by cystic calculi or sediments, may continue indefinitely if the cause of the disease be not removed. Catarrhal cystitis usually disappears in a few days.

Prognosis, and indeed treatment, therefore, depend on the indications furnished by a careful examination of the urine, which must be considered in conjunction with the symptoms. It should be remembered that many of these diseases have a great tendency to recur.

Treatment. Some benefit results from the administration of medicines which, excreted with the urine, exert a curative effect on the cystic mucous membrane, but direct treatment is always more effectual. Boric acid, salol, salicylic acid, biborate of soda, chloride of potash, and other medicines have been used, and may prove of service in simple catarrhal inflammation.

But immediately putrefactive changes, especially alkaline fermentation of the urine, appear, local treatment must be resorted to. The urine should be drawn off, and the bladder irrigated, two or three times a day, through a gum-elastic catheter or rubber tube

with salicylic acid (one per cent. watery solution), carbolic acid (0·5 per cent.), sublimate (0·5 per 1,000), boric acid (2 per cent.), resorcin (1 to 2 per cent.), protargol (3 per cent.), nitrate of silver (0·5 to 1 per cent.), or tannin (1 to 2 per cent.). The chief difficulty is, that in male animals the treatment can only be carried out by experts. The lotions should, of course, be warmed to body temperature. Concretions and sediments are removed by vigorously washing out the bladder, or by surgical operation. Chronic cystitis in the dog has lately been treated with salol, which renders the alkaline urine acid, clear, and free of offensive smell; It is well borne by the stomach, and is decomposed by the pancreatic juice in the small intestine into salicylic acid and phenol. This treatment may be supplemented by giving milk diluted with Vichy water, or by frequent doses of sodium bicarbonate. Constipation should be relieved by oil or glycerine enemas, or by cascara pills.

VII.—PROLAPSE, RETROFLEXION AND INVERSION OF THE URINARY BLADDER.

IN cows and sows infrequently in bitches, the lower wall of the vagina is ruptured during delivery, the urinary bladder passes through the opening, and may even project beyond the vulva (prolapsus vesicæ). The condition is distinguished by the prolapsed viscus being covered with serosa. Gradually it becomes distended, and assumes an almost spherical form; small quantities of urine are discharged on pressure. By introducing the hand or finger into the vagina close to the prolapsed portion, the rupture in the lower wall can be felt. Occasionally in dogs and pigs the bladder may be found in perineal and inguinal herniæ, and its presence is seldom recognised before opening the hernial sac.

Diagnosis of prolapse is seldom difficult; but as the condition occurs during parturition, the swelling might possibly be mistaken for the presenting foetal envelopes, and grave results ensue if perforated under this erroneous idea. In the dog retroflexion of the bladder is sometimes produced by the repeated expulsive efforts which occur in obstinate constipation, enlarged prostate, and difficult parturition. The pelvic connective tissues give way gradually under the pressure on the bladder, which is forced back towards the anus where it forms a soft, cyst-like swelling between the anus, buttock, and base of the tail. Micturition is slow, but usually the urine can be expelled. Occasionally, when the urethra is bent or compressed, there is retention with straining, colicky pains, and suddenly

increased tension of the swelling. The condition may be mistaken for an abscess, and care is required in applying treatment.

Inversion of the urinary bladder is a condition in which the bladder is turned inside out, passing through the urethra something like a reversed pocket; the accident has up to the present almost always been observed in mares during or soon after parturition. Gröger saw it in a mare which had shortly before aborted, and suffered rupture of the perineum. Lönnecker noted inversion in mares both during pregnancy and after parturition. Lanzillotti has recorded



FIG. 438.—Inversion of the bladder in a mare.

57 cases : 53 in mares, 1 in a cow, 1 in an ass, and 2 in sows. Esser diagnosed the condition in sows, also after parturition. It therefore seems that about this time the urethra is abnormally dilated, a condition necessarily antecedent to inversion of the bladder. Mann saw a mare in which the inversion did not occur until three weeks after parturition. Rauscher speaks of a two-and-a-half year old filly which suffered from inversion. Forceful dilatation of the urethra in mares, practised for the removal of cystic calculus, may lead to inversion if the muscles of the abdomen are powerfully contracted.

Inversion of the bladder is distinguished by the presence of a spherical swelling, of variable size, either in the vagina or protruding beyond the vulva (Fig. 438). It appears to be tough, elastic, with a moist corrugated surface of a reddish colour, and on the upper aspect of its attached or constricted extremity the orifices of the ureters may be seen as nipple-like prominences within two folds of the mucous membrane

By lifting up the swelling, or pressing on it, or on moving the animal, urine (from the distended ureters) trickles from it, or spurts in a double stream (Fig. 438).

The mucous membrane by continuous exposure gradually dries, is soiled by dirt and dust, and may finally become necrotic. When the condition has existed for a long time stenosis of the urethra may lead to strangulation of the bladder, which is shown by severe congestion, and sometimes ends in rupture.

Prognosis. Prolapsus vesicæ is evidently graver than inversion, as the peritoneal cavity is opened and peritonitis is liable to occur, a danger which is absent in inversion. Reposition is only possible in recent prolapse, where the serosa of the bladder has undergone no considerable change. Otherwise septic peritonitis occurs, and invariably proves fatal. The prognosis is more favourable in *inversio vesicæ*; the mucous membrane of the bladder possesses greater resistance, and even when, after successful reposition, irritation is marked, cure is not impossible. The animal's progress depends principally on the condition of the mucous membrane and on the calibre of the urethra. As long as these allow of reposition, operation must be attempted, as, in the event of its failing, nothing remains but amputation of the bladder. Failure to distinguish inversion of the bladder from fœtal membranes has sometimes led to awkward consequences both for patient and operator.

Treatment. Provided the serous coat of the prolapsed bladder is little changed, it should be carefully cleansed with disinfectants and attempts made to replace the viscus. At the same time the wound in the vagina must receive attention. Unless the animal strain much, a repetition of the prolapse need scarcely be feared, and can be provided against by injecting lukewarm fluid into the replaced bladder. Rivière diagnosed prolapse of the bladder in a cow soon after labour. The rupture in the vagina was $3\frac{1}{4}$ inches in length. After discharge of the contents, the bladder was replaced, and though severe straining ensued, the condition did not recur. Recovery was complete. When the rupture in the lower wall of the vagina lies not far from the vulva an attempt might be made

to suture it, to prevent recurrence and to guard against the passage of urine into the abdominal cavity.

For **retroflexed** bladder in the dog, with no great difficulty in urinating, a laxative diet should be prescribed. If retention occur, enemata of oil or warm water should be given; while reposition of the bladder may be effected by raising the dog's hind quarters and applying light pressure to the swelling. A finger inserted in the rectum may prove of much assistance in the necessary manipulations. If the bladder is much distended, it must be punctured—using a fine hollow needle—and the urine drawn off; afterwards further efforts at reduction should be tried.

When the bladder becomes **inverted**, the first point is to effect reposition before the mucous membrane is much altered. After expelling the peritoneal fluid from the inverted bladder by pressure and cleaning the prolapsed part, the animal may be placed with the hind-quarters high and a twitch applied; but operation under anæsthesia in the recumbent position should be preferred. The urethra is sometimes so wide that the displaced bladder can be passed through it with the hand, but should it prove too narrow, a blunt stick, well rounded off at one end to prevent injury to the bladder, may be employed. Lönnecker employs a probang for this purpose. The hand or stick is placed on the base of the bladder and the latter gently pushed through the urethra. By injecting a lukewarm fluid like boric acid lotion, diluted alum lotion (1 to 5 per cent.) or tannin (1 to 2 per cent.), recurrence may be prevented and inflammatory reaction checked; such solutions also favour contraction of the urethra. By slow exercise, pressure on the loins, or by administering an anodyne, straining and possible recurrence may be obviated.

Lönnecker replaced an inversion, but as it reappeared five days later he sewed up the orifice of the urethra, grasping and raising the mucous membrane with the left hand, and passing a lead wire through it, after which recovery took place. Holgen successfully effected reposition five weeks after the first appearance; probably the bladder was not continuously exposed. The same applies to the case related by Degive, in which reposition or reversion was successful fourteen days after the viscus first protruded.

As a rule, however, the surface of the mucous membrane is so much injured during prolonged exposure as to become necrotic, in which case reposition is contra-indicated, and amputation of the bladder offers the only chance of recovery. Though this certainly deprives the animal of the natural reservoir for the urine, which, therefore, flows continuously or is discharged in small quantities

from the vagina, yet as it does not render ordinary working-horses and cows useless its employment is sometimes justified.

Partial amputation of the bladder is generally effected by ligation, care being taken to avoid including any portion of the ureters. As the ligature tends to slide forwards off the spherical swelling and over the ureters, different methods of operation have been suggested. Some recommend transfixing the bladder and ligaturing on both sides, that is, applying two ligatures. Others prefer the simple ligature, transfixing the bladder with a needle in front so as to secure the ligature in position. Bang passes a second ligature in front of and at right angles to the first, and after cutting away the bladder carries the ligatures backwards and ties them in the form of a cross. The same result is more simply attained, without transfixing the bladder, by laying a tape with its two ends above and below the neck of the bladder, the rest of the tape extending over the bladder in the middle line; the ligature is then applied, embracing the tape, and the two free ends are carried backwards and tied at the back of the protrusion. If the bladder be not immediately cut off after ligation, it sloughs away in a few days, though, unless elastic ligatures are used, it is necessary to tighten the ligatures at intervals during the next few days; the elastic ligature is, however, much preferable. A sound may be passed into the ureters to ascertain their position before securing the ligature. When adhesions have already occurred between the layers of peritoneum covering the bladder, it may be simply cut away, as was done by Gaullet in the case of a mare. The bleeding was insignificant and recovery soon occurred. As, however, it is never certain that the adhesions are firm, the ligature deserves preference. The portion of bladder not included in the ligature gradually retracts into the vagina after the free portion has sloughed, and the external appearance of the animal is not much injured.

VIII.—TUMOURS IN THE URETHRA AND BLADDER.

NEW growths in the urethra soon impede urination; hence the animals are either slaughtered or die of the condition, and opportunities of noting or treating tumour of the urethra during life are rare. Matthias, however, found a polypus of the urethra in a gelding. Vorberg, 10–12 polyp-like new growths in an ox; they were $\frac{1}{4}$ to $1\frac{1}{4}$ inches in length, and closely packed together at one spot. The polypus noted by Matthias was 6 inches long, $1\frac{1}{2}$ broad, and had its

seat not far from the orifice of the urethra, so that it could be grasped with dressing forceps and removed.

New growths in the bladder are more frequent; they may be either innocent, like fibromata, lipomata, myxomata, or malignant (cancer).

The collection in Copenhagen contains the bladder of a cow with "fibrous cancer" (Bang). Pflug has seen carcinoma of the bladder in a horse. Siedamgrotzky described epithelioma of the bladder in the horse; the disease had extended to the peritoneum and caused secondary growths in the omentum. He also found in oxen leucocythæmic infiltration of the wall of the bladder, the uterus, and the ligaments of the uterus. Esser was able to diagnose by manual examination from the rectum during life a large papilloma in the bladder of a cow. Wolff and Leisering discovered myxomata in the same region. Cows appear to suffer from new growths in the bladder oftener than horses, not infrequently from carcinomata; tuberculous growths are common near the openings of the ureters in the Trigonum Vesicæ Lieutaudii. Barnick discovered a tumour twice as large as a man's head in the bladder of a horse which had died with symptoms of difficulty in urination and colic. Tright found a myoxma of the bladder in a dog.

Demeurisse diagnosed cancer of the bladder in a bitch suffering from cancer of the udder; the growth could be recognised as a painful swelling on examination per anum. The animal showed progressive emaciation and died in a short time; on post-mortem a perforation was found in the upper wall of the bladder, through which urine had flowed into the abdominal cavity. Near the neck of the bladder lay a carcinoma which had prevented the passage of urine.

Symptoms. Tumours in the urethra are recognised, like strictures, by their causing gradually increased difficulty in urination. During the act the stream of urine becomes smaller and smaller, until finally drops alone are passed. Displacement of the tumour, slight swelling of the mucous membrane, or the formation of a blood clot may tend to the sudden development of symptoms. On passing the catheter the obstruction is found to be more or less soft, which differentiates a tumour from a urinary calculus.

The growth of tumours in the bladder gradually diminishes its capacity and causes urine to be passed more frequently. New growths sometimes cause profuse bleeding; the urine takes on a bloody character, usually clots of various sizes are discharged; dysuria may also occur, especially if the tumour lie near the neck of the bladder. Purulent inflammation in some cases accompanies new growths; the urine appears turbid, and on standing deposits a sediment. The presence of tumours in the bladder is often signalled by the deposit of salts and the formation of precipitates, hence microscopical and chemical examination of the urine should be employed to discover

the origin of turbidity. The symptoms having suggested tumour formation, the diagnosis can be verified by examination per rectum or per vaginam. Not until the new growth attains a considerable size does it give rise to disturbance; a soft mass may be felt in the bladder, just as a hard mass may be felt when a calculus is present. In mares and cows the swelling may sometimes be felt from the urethra.

The prognosis is usually unfavourable. Only when the new growth is near the outlet of the urethra and can be removed is prognosis hopeful. Though tumours in other parts of the urethra may occasionally be removed by performing urethrotomy, yet their existence and position can seldom be so exactly determined as to justify operation, especially as more or less serious consequences always ensue. Removal of tumours from the bladder is likewise very difficult, and this of itself sufficiently explains the unfavourable character of the prognosis.

Treatment. Pedunculated tumours near the free end of the urethra may be torn away with dissecting or dressing forceps. Where in male animals the growth cannot be grasped, the lower wall of the urethra is laid open. The position of the tumour and the practicability of operation having been ascertained, removal may sometimes be effected by opening the urethra. Urethrotomy may be resorted to as a palliative when animals have to be kept alive for some time to gain condition or to be prepared for slaughter.

Cystic tumours are seldom removed, being generally recognised too late for successful operation. Schmidt and Mogford have, however, recommended everting the bladder in mares to remove tumours. Schmidt states having carried this out in the horse, and having removed a polypus weighing 40 ounces. Mogford declares eversion of the bladder to be easy in mares. After removing the tumour the bladder is washed out, and the concretions which often occur here removed. Mogford, however, does not give any satisfactory description of his method.

Nevertheless, both in mares and cows, it is worth trying to dilate the urethra, so as to be able to enter the bladder with polypus forceps or the hand. Though the method is certainly not easy, there seems no doubt that where it succeeds tumours may be removed and recovery effected. Levens thus removed a fibroma as large as a goose's egg, which lay at the neck of the bladder in a cow. Eversion of the bladder would probably often follow dilatation of the urethra if the animal were not chloroformed. Anæsthesia is therefore advisable in horses, and even in cattle, especially if not intended for immediate slaughter.

In dogs and other small animals tumours may be removed from the bladder by resorting to laparo-cystotomy (see under "Urinary Calculi").

Schmidt removed a cystic polypus from a gelding by performing urethrotomy, and breaking down intervening tissues as far as the neck of the bladder; he was then able to excise and extract the pedunculated tumour; the operation wound healed in eighteen days. Heyne describes a case of fistula between the small intestine and bladder, a rather rare condition. The small intestine was adherent to the base of the bladder, with which it communicated by an opening $\frac{3}{4}$ to 1 inch in width. The animal had suffered from weakness, defective appetite, diarrhœa, and great emaciation.

DISEASES OF THE MALE ORGANS OF GENERATION.

I.—INFLAMMATION OF THE PREPUCE.

THE prepuce, consisting of a duplicature of the skin, is liable to inflammatory changes, which present very notable differences in symptoms, course, and results, in the various classes of animals.

Inflammation of the sheath (acrobystitis or posthitis) and inflammation of the glans penis (balanitis), may exist separately in the horse, but in the dog and bull they are often associated, constituting balano-posthitis.

(1.) INFLAMMATION OF THE PREPUCE IN THE HORSE.

In the horse the covering of the penis is peculiar in that it consists of a double involution of the skin, that is, it is formed of an inner fold (prepuce in the narrow sense of the word) and of an outer, the so-called sheath. The visceral portion of the first covers the end of the penis, clothing it closely, and lying, when the penis is not erected, in folds, but these disappear on erection. The outer fold forms a layer as thick as the finger, attached to the under surface of the member by the inner fold of the sheath; the latter presents a second considerably thicker covering, which is reflected backwards at the entrance to the sheath, to become continuous with the skin of the scrotum. The inner lining of the sheath and the outer fold of the prepuce are provided with numerous sebaceous and sweat glands, the secretions of which, together with the loosened masses of epidermis, form a blackish-grey fat-like material (smegma preputii).

In horses inflammation of the prepuce is not infrequently produced by the animals failing to extend the penis during urination, and discharging the urine into the prepuce. This produces continuous irritation, thickening and subsequent contraction of the folds of skin, and finally stenosis of the outer folds of the sheath, which renders it impossible for the animal to expose the penis (phymosis). As in this condition more smegma always accumulates, the escape of urine may finally be seriously interfered with. Sometimes a large quantity of the material accumulates around the corona glandis, filling the sub-urethral sinus and rendering urination difficult. Cases of the kind are common. Colic, distension of the bladder, and ineffectual straining to pass urine, set in; sometimes urine is only

discharged in drops. Geldings frequently suffer from this condition, which also affects entire horses.

Local examination discovers narrowing of the opening of the sheath by accumulation of preputial smegma which also fills the sub-urethral sinus. Cadiot saw a horse in which the sheath had become so enormously enlarged that it hung down as low as the hocks; the condition had been brought about by a wound of the prepuce; which was followed by adhesion between it and the penis; urine was then passed into the sheath. Partial removal of the sheath was followed by recovery.

In many districts horses suffering from colic or difficulty in urination are treated by rubbing the penis and sheath with irritant substances like pepper, which afterwards produce extensive painful swelling of the penis and sheath, exudation from the surface, and finally ulceration. If applied freely and energetically they may even cause necrosis of the skin; the penis then protrudes from the sheath in a more or less swollen condition, while the preputial fold may be as large as a goose's egg. The inflamed parts are doughy, painful, of increased temperature; and if the penis itself, or the prepuce covering it, is greatly swollen, the pressure on the urethra may interfere with urination. Inquiry generally reveals the nature of the substance employed.

The inflammatory symptoms generally disappear without having caused permanent damage, though the sequel depends largely on their degree and extent. Provided urination is unimpeded, no very bad results need be apprehended, but when paraphymosis sets in, as is sometimes the case, treatment becomes difficult.

Treatment consists in cleansing the prepuce, particularly the sub-urethral sinus, so as to allow free exit of urine. Washing with warm water and soap assists the removal of smegma. As a rule, this causes immediate improvement and if the sheath be regularly cleansed the case usually does well. Inflammation of the prepuce and penis produced by irritants like pepper calls for careful cleansing of the parts and bathing with astringents such as alum lotion. Excoriated parts may be covered with a non-irritant fat, with zinc or lead ointment, or powdered with iodoform, tannin, lycopodium, or similar materials. To assist resorption and removal of swelling, a suspensory bandage may be applied, and the animal placed in a clean dry stall.

Where the opening in the sheath is much diminished in calibre, it may require to be laid open, which in quiet animals can be done standing. To prevent the edges of the wound reuniting, they can

be held open by sewing them to the neighbouring skin, an operation which is not difficult if the sheath be divided on its under surface.

Hering divided the cutaneous portions of the prepuce in a stallion which had difficulty in erection; four months later he completely excised them; but as the prepuce contracted and caused the penis when in a state of erection to be directed backwards the animal had difficulty in covering, which was only removed by once more dividing the cicatrices and preventing reunion.

(2.) INFLAMMATION OF THE PREPUCE IN OXEN.

The prepuce of the ox, formed by a simple infolding of the skin, presents a long narrow sheath, the entrance to which is small, and is provided with a bunch of long strong hairs. The inner fold consists of mucous membrane, presenting some resemblance to the cutis, and displaying numerous follicles and papillæ. It lies in longitudinal folds. The prepuce is moved by two muscles, so as to render the act of urination easier.

The chief sufferers from inflammation of the prepuce are oxen, bulls are less frequently affected. Oxen do not usually extend the penis during urination, especially if the opening of the prepuce has already become painful and constricted on account of inflammation. The smegma, usually decomposed and soaked in urine, accumulates in increasing quantities within the prepuce, until finally it impedes urination. Accidental injuries to the sheath may also prevent protrusion of the penis, and give rise to this disease. Gurlt found a head of wheat in the inflamed sheath. An abnormally irritant condition of the urine has also been regarded as a cause.

Bulls sometimes suffer from contagious balanitis, contracted in service from cows affected with contagious vaginitis; and probably bulls convey the infection to cows. Dotter saw enzootic outbreaks of this form of inflammation which he regarded as due to contagion. Röbert had a similar experience; he regarded the straw, which was very bad, as the offending material. After provision of fresh bedding and disinfection of the paving the outbreak ceased.

Albrecht noted a case of croupous inflammation of the visceral layer of the sheath; he laid open the parts and removed a mass of fibrous material and broken down tissue saturated with urine and of very offensive odour. Recovery followed the free use of lysol and creolin in six weeks.

Symptoms and course. A longish swelling, which is hot and painful, first appears at the front of the sheath, and may extend as far as the scrotum. Urination is difficult, and the urine is passed

in drops or in a fine stream. The prepuce cannot be drawn back over the penis; phymosis exists. In the prepuce a grey-black smegma is found, the removal of which gives pain. The bladder, when examined per rectum is found greatly distended and painful on pressure. Colic soon sets in. The animals stop feeding, may show fever, and if relief be not soon afforded may die.

The risks are numerous. There is, firstly, the chance of necrosis of the prepuce and penis; sloughing of large portions of the penis has often been observed. Then there is the danger of infiltration of urine into the subcutaneous tissues, causing septic cellulitis, necrosis, and severe general disturbance from infection. Finally, rupture of the bladder may be threatened. The condition is, therefore, in no way trivial, and imperatively calls for early treatment.

Treatment consists in cleansing and making patent the orifice of the prepuce to allow of urine escaping; if the entrance is too much swollen and no urine is passed, the prepuce must be laid open. As the animal strikes out when the penis is handled, it should be placed in stocks, or restraint applied. If stocks are unavailable, restive animals may be placed against a wall, the hind legs being secured by a rope applied above the hocks; Pflug recommends casting such animals. On account of the great pain, it is often impossible to free the entrance to the sheath in the standing position. The bunch of hairs must first be cut away, and lukewarm oil injected into the prepuce, whilst its outer surface is rubbed with the same material. If urination is moderately free, the animal may then be allowed to rise, and the task of emptying the prepuce left until next day. To facilitate this, Pflug first injects lukewarm water, solution of acetate of lead or Goulard's solution. Others recommend a 5 per cent. solution of chloride of lime. Permanganate of potash (3-5 per 1,000), sulphate of zinc, tannic acid (3-5 per cent.), are also useful. The points to be kept in view are to cleanse the sheath as completely as possible, to remove decomposing material, or destroy its injurious properties by disinfectants, and to combat the inflammation. Bathing the sheath, or frequently washing its surface with lukewarm water, is therefore first indicated. Necrotic parts should be removed, or their separation assisted by bathing with lukewarm aromatic fluids, or frequently washing them with warm carbolic lotion.

In many cases it is necessary to lay open the prepuce. A strong probe-pointed tenotome is introduced, and the cut made either downwards or to one side. Pflug prefers the latter direction on account of the parts not being so easily moistened by urine, which is likely to produce fresh strictures. For contagious balanitis in

bulls injections of sublimate (1:1,000), or zinc chloride, 5 per cent., should be tried.

When the subcutaneous tissue about the sheath is infiltrated with urine, incisions are made, the parts pressed to remove the contents, and the skin and wounds frequently cleansed.

(3.) INFLAMMATION OF THE PREPUCE IN SWINE.

The prepuce of the boar consists of an inversion of the skin, but the inner surface is formed of mucous membrane containing numerous lymph follicles. On the upper wall of the sheath, and close in front of its opening, is the "umbilical pouch" (nabelbeutel) formed by folding of the mucous membrane, which, when distended, often attains the size of a hen's egg. It is lined by squamous epithelium, and contains numerous sebaceous and sudoriferous glands, hence smegma not infrequently accumulates at this point, and, becoming inspissated, may produce "preputial calculi."

In swine, only the castrated animal seems to suffer from inflammation of the prepuce; the causes are similar to those in oxen. They consist in accumulation of smegma in the prepuce, or in the above-mentioned appendix; if swine were not slaughtered so early in life, the condition would probably be seen more frequently.

Symptoms. The prepuce is swollen, painful, hot, its orifice contracted, and not infrequently there is difficulty in urination. A stinking sebaceous material escapes on pressure. This material sometimes stops up the prepuce and fills the umbilical pouch causing it to protrude as a round swelling above the end of the penis.

Treatment is on the same principles as in cattle, and consists in evacuation of the sheath and pouch cleansing and disinfection as far as possible. The same materials may be employed as in oxen; sometimes it is necessary to lay open the sheath.

(4.) INFLAMMATION OF THE PREPUCE IN CARNIVORA

Presents somewhat different features to the corresponding condition in bulls, oxen and horses. Apart from accumulation of smegma, infection or accidental injuries, preputial inflammation is rare in these animals but dogs suffer frequently from chronic catarrh of the inner surface of the prepuce; indeed, most suffer from it to a limited extent.

Symptoms. The hairs clustered round the opening of the sheath appear gummed together, and a purulent material discharges from the prepuce. In some cases the urethra is also affected. Animals are inclined to lick the affected parts, but apart from this there is

little disturbance, and no difficulty exists in urination. Neither the mucous membrane of the prepuce nor of the glans is much altered, and the disease seldom requires treatment except in house-dogs. The causes are unknown. The popular idea that the disease is related to similar affections in man appears unfounded.

Treatment demands a good deal of patience. Injections of astringents (sulphate or sulphocarbonate of zinc, 1-2 per cent. ; tannic acid, 3-5 per cent. ; permanganate of potassium, 1 per 500), diminish the secretion, which, however, returns as soon as the treatment ceases. Even painting the inner surface of the prepuce with 1-5 per cent. nitrate of silver solution is seldom of permanent benefit. The owner or attendant may be entrusted with the application of the solution, and instructed to use it three or four times a week.

II.—PHYMOSIS, PARAPHYMOSIS, PARALYSIS OF THE MUSCLES OF THE PENIS, INJURIES TO THE PENIS.

PHYMOSIS consists in an abnormally narrow condition of the preputial opening preventing exposure of the glans. This contraction may finally cause difficulty in urination, or render it impossible. Phymosis seldom occurs congenitally in animals, but has been seen in dogs ; and it is produced by inflammatory swelling of the prepuce or cicatricial contraction (compare with " Inflammation of the Prepuce "). Under certain circumstances, it may form the primary disease, and lead to retention and inspissation of smegma with formation of so-called preputial calculi. Miller saw phymosis in a bull with adhesion between the penis and prepuce, caused by a layer of strong connective tissue. After dividing the adhesion, the bull was incapable of coitus.

Paraphymosis is a condition in which the glans cannot be retracted into the prepuce, because either the opening is too narrow or the glans too large. The peculiar formation of the penis and prepuce in the dog explains why it is so frequent a sufferer. In horses the outer fold of the sheath presents a wide opening through which the penis is easily retracted, though, when the preputial folds are greatly swollen, its return is sometimes impossible,—a condition which has been described indifferently as paraphymosis or paralysis of the penis. Whether simple paralysis of the muscles concerned in withdrawing the penis into the prepuce ever occurs is doubtful. In such case the retractor penis, which derives its motor filaments from the 4th and 5th lumbar nerves and from the N. hæmorrhoidalis posterior, would probably be affected. In disease of the spinal cord, we

certainly sometimes see paralysis of the muscle in question. More often the condition is due to injury of the penis, causing swelling of the glans and hindering its withdrawal into the sheath. Several reported cases also point to thrombosis of the vessels of the penis itself. Bang saw a gelding with thrombosis of the veins of the sheath.

In the horse, inability to retract the penis is rarely caused by contraction of the outer folds of the prepuce. Their width and disposition are unfavourable to the production of paraphymosis; but swelling of the inner folds may in these animals cause prolapse of the penis and inability to retract it. Such swelling, incorrectly described as paralysis of the penis, occurs temporarily during inflammation of the sheath and neighbouring parts, as, for example, after castration or injury to the penis. Slight wounds are sometimes followed by cellulitis of the sheath, as Haase noted after a blow from a whip. Möller has repeatedly seen this condition after irritant substances like pepper had been rubbed into the penis and sheath. Bang noted it in a gelding, following thrombosis of the veins of the sheath.

Swelling of the prepuce often remains after subsidence of the inflammation and interferes with the return of the penis. Inflammatory symptoms being absent, such cases have erroneously been looked on as paralysis of the penis. Cases do occur, however, where nothing abnormal can be detected either in the penis or prepuce, and yet, despite this, the glans cannot be retracted, or if replaced within the prepuce, at once falls forward. In such cases the retractor penis may be paralysed. Paralysis may also afford an explanation of the cases which follow diseases like influenza and purpura hæmorrhagica (Cagny); but at present we have no accurate information on the point. Injury and ulceration of the penis often occur as sequelæ of paralysis, as the penis occasionally protrudes to such an extent as to be struck by the hind feet and wounded during movement.

Local examination does much to differentiate the nature of the case. When no change is visible, and the penis is insensitive to pricks or pinches, paralysis may be surmised. In paralysis of the retractor penis, sensibility remains unimpaired. Particular attention must be paid to the prepuce; it suffers more frequently than is generally supposed.

Ruminants and swine very seldom suffer from paraphymosis, because in oxen the glans is very small, and in sheep and swine is altogether wanting. In dogs the condition is favoured by the presence

of long hairs around the prepuce, and it is often seen after coitus. Should the hairs become adherent to the penis during erection, their ends are apt to be afterwards drawn back into the prepuce. The edge of the latter is rolled round its outer surface, is turned inwards, and the further return of the penis prevented. The glans then begins to swell, which, of course, aggravates matters. Swelling of the glans from inflammation or new growths may also produce the condition. Bang found a ribbon twisted round the penis of a dog ; the parts were much swollen.

The glans is exposed, and shows more or less cedematous swelling ; its surface is shining, bright red, sometimes of a darker tint, often covered with dirt and dust, and not infrequently dry. The prepuce is tightly applied behind the swollen glans, strangulating it. When the disease has existed for some time, the parts may be injured or ulcerated. Haubner once had to remove the glans and os penis on account of necrosis ; recovery followed in fourteen days. Apart from those caused by malignant new growths about the glans or by severe wounds to the penis the greater number of cases progress favourably without very elaborate precautions.

Prognosis depends on the nature of the disease. Paralysis of the penis or of the retractor penis is generally incurable. Only those forms occurring during infectious diseases disappear with the lapse of time. The longer, therefore, the condition has existed, the less the chance of recovery. Swelling of the prepuce is often very obstinate, and old standing cases are most difficult of treatment. Hard, firm swellings are less easy to get rid of than those which are soft and cedematous.

Treatment. In the dog after thoroughly cleansing the glans and prepuce, the displaced hair must be withdrawn or cut off with scissors. A few drops of oil can then be placed on the glans and tense prepuce, the animal placed on its back, the prepuce grasped on each side with the forefinger and thumb, and attempts made to draw it over the glans. The attempt generally succeeds ; slight pressure with the finger on the glans is sometimes of assistance. Failing reposition in this way, the lower border of the prepuce may be laid open, when the penis will return of itself. Any subsequent inflammation is combated by bathing with solution of acetate of zinc, alum, &c. ; this is, however, seldom necessary.

Inflammation of the prepuce is to be treated as already described. Should the outer coats of the sheath be already contracted, they may be divided. Application of a suspensory bandage will assist removal of œdema, and is also useful in swelling of the prepuce. The

bandage is formed of a triangular piece of linen; one angle lies on either side of the penis, and is continued by a bandage, which is passed over the animal's back and tied in a knot. The angle of the suspensory bandage, directed backwards, is stitched to two pieces of linen, which are passed between the hind legs, brought upward and forward, and finally united with the transverse strips.

It is advisable to place a pad of tow, jute, or wadding next the penis to support it and prevent chafing. The pad must be renewed when soiled with urine, and the linen cleansed or replaced from time to time. The pad may be soaked in acetate of lead or alum solution, and occasionally moistened with the same fluid.

In old painless swellings, especially swellings of the prepuce, massage is recommended. The swelling can be kneaded daily for five to ten minutes at a time; but to avoid injury, the parts should previously be smeared with fat. Attempts can then be made to return the penis, and if it again protrudes it may be held in position by passing a couple of stitches through the sheath.

To lessen the size of the glans and thus facilitate its return, an elastic bandage may be used. The parts are cleansed, several turns of the bandage applied to the glans, and left in position for a few minutes. In very severe swellings this may need to be repeated two or three times. The glans is then either drawn back or, after being douched with cold water, may be returned to the prepuce. This method can be recommended.

In case the preputial swelling still persists, benefit sometimes results from scarification and bathing with such astringents as solution of alum or acetate of lead. Needless to say, a suspensory bandage must be worn during massage treatment. Failing improvement by any of these methods, a portion of the prepuce may be amputated. The animal is placed on its back, the penis drawn forwards as far as possible, the prepuce cleansed, and the preputial swelling isolated by multiple silk ligatures in the manner usual in ruptures and new growths; the swelling itself is then removed with knife or scissors. Haase and others have frequently seen the best results from this treatment; the penis remained in position, and the inflammation consequent on operation was so slight as to require no treatment.

In paralysis of the penis, massage of the retractor penis muscle between the anus and scrotum may be tried; injections of veratrin, strychnine, or similar nerve stimulants might possibly prove useful. The paralysed penis is shielded from external injury by applying a suspensory bandage. In case of need, it can be amputated.

In the horse, injuries to the penis are most frequently caused during prolapsus by accidental blows, as with the whip. Extensive wounds are sometimes caused in stallions during coitus. In bulls, injuries may likewise be caused by the penis failing to enter the vagina and striking against the ischia of the cow. In such cases laceration sometimes takes place, the corpora cavernosa are ruptured, bleeding occurs, and marked bending and distortion ensue; the condition has also been seen in the horse. Similar injuries have also been caused by ignorant castrators applying a clam to the penis, instead of the testicle. Lambert and Kobert report such cases, in one of which the testicle lay in the abdomen. As the horse suffered from colic on the following night, and made fruitless efforts to pass urine, the clam was removed, and recovery occurred, but amputation of the penis was found necessary. In dogs, injuries of the penis are caused by bites and violently separating the animals during coitus.

The first serious symptom which occurs is difficulty in urination. Either the injury itself or the inflammatory swelling consequent on it compresses or displaces the urethra and produces obstruction. Such injuries sometimes produce cicatricial strictures. Lacerations of the penis generally do well, that is, the distortion or bending disappears along with the inflammatory symptoms, though cases have been seen where it persisted, and rendered the animal useless for stud purposes. Gallimore reports a case where the end of the penis no longer became erect.

Treatment must be based on general principles. To assist circulation, and repair and prevent the wound becoming soiled, a suspensory bandage is employed, and may be made the vehicle for the application of cold astringent lotions, &c.; the swelling which usually remains will thus be most rapidly removed, and for the same purpose massage will be found of service.

III.—AMPUTATION OF THE PENIS.

THE greater part of the penis consists of the corpora cavernosa, which, together with the urethra and blood-vessels, are surrounded by the firm fibrous tunica albuginea. At the lower border of the penis lies the urethra in a furrow, surrounded by the corpus spongiosum, cavernous bodies and muscles. The arteria and vena dorsalis penis form the large blood-vessels. In dogs the os penis must also be considered in operating.

In amputation of the penis, three factors are to be reckoned with, viz. :—

- (a) The bleeding.
- (b) The after-contraction of the urethra.
- (c) The pain.

Amputation may be rendered necessary, as described, by the presence of tumours, by paralysis, and by inflammation and necrosis of the penis. The following methods have been proposed :—

(1) Ligation. This gives the greatest security against bleeding; is, however, very painful, and requires particular care to preserve the urethra. To prevent its occlusion from pressure of the ligature, the urethra must previously be dissected out, or a metal tube thrust into it to keep it open. The elastic ligature is particularly valuable, and will be considered later. Hertwig recommends the castrating loop. By daily tightening the cord, the penis is cut through in from six to eight days. When the ligature has to be applied high up the prepuce must previously be laid open.

Ligation is, of course, useless in dogs over the region of the os penis.

(2) The actual cautery. To prevent bleeding, a knife-shaped cautery has been recommended. Its application is very painful, but the pain may be avoided by narcosis. The urethra is exposed, and the penis cut through with the cautery. In order to fix it conveniently, two ligatures are passed around it, and the division made between them; particular care is required in severing the dorsal vessels. Nocard recommends the galvano-cautery for small animals, though it is not always to be found even in large clinics.

(3) Simple section. It has often been remarked that even in large animals simple section produces no dangerous bleeding. Some operators first ligature the dorsal vessels, others cut through them at once; Barthélémy and Charlot operated in this way in the horse, Fellenberg in the dog. Two ligatures are applied, between which the amputation is made; the upper ligature prevents bleeding. That even this is not always necessary is shown by a case of Hunting's, where a pony's penis was simply cut through, the stump compressed by an assistant for half an hour, and no particular bleeding ensued. If the horse is cast for operation, that portion of the prepuce covering the penis may be drawn together with sutures in front of the stump. Haase operated in this way, using catgut, and states having had healing by primary intention. In such cases it is necessary to expose the urethra, and divide its mucous membrane, which is stitched to the tissues on either side to prevent stricture.

If the animal is cast, the actual cautery may be employed after section to check bleeding. It is better to ligature each bleeding vessel separately, and in the horse to draw the integument over the stump and suture it in that position.

(4) The *écraseur*. This method and removal by galvano-cautery or ligature are the most painful, but the operation only lasts a short time, and an anæsthetic can be given.

After cleansing the penis and sheath, a piece of tape is tied around the end of the former to furnish a good hold. The urethra is then dissected out for 1 to 1½ inches and cut through, after which the *écraseur* is applied at the point to be divided and slowly turned. There is little resistance whilst the corpora cavernosa are being compressed and cut through, but towards the end of the operation it becomes greater, because the tunica albuginea is then undergoing division, and at this period the chain may occasionally be broken. In such cases one may pass a ligature round the remainder, and simply remove the end of the penis with a knife; experience has shown the operation to be perfectly successful, and healing has occurred rapidly and uninterruptedly. Möller always operates in this way. Not only is injury to the instrument avoided, but bleeding is very slight and the wound heals rapidly. The urethra may be sutured to the integument of the penis, and if sterilised catgut or silk be used its edges soon become adherent, and the danger of stricture is reduced to a minimum.

Nevertheless, whatever method be employed, stricture forms the most frequent and most troublesome sequel of amputation of the penis.

The insertion of a metal tube in the urethra during the first week or two certainly obviates difficulty in urination consequent on inflammatory swelling, but later it operates in exactly the opposite way, and it is, therefore, better to avoid such tubes. Stricture usually leads to rupture of the bladder, as Cagny and others have shown.

Contraction of the urethra may be avoided by one of the following methods.

The first consists in cutting through with the bistoury or cautery all the tissues of the penis except the urethra, which, after having been carefully dissected out, is divided about three-quarters of an inch in front of the surface of section. This kind of artificial urethral tube is afterwards divided vertically and transversely, so as to form four flaps, each of which is fixed to the integument of the penis by means of sutures. In another method, derived from human surgery, and skilfully modified by M. Guyon, a reversed V-shaped incision is made immediately above the line of amputation and on the lower surface of the penis, the integument being first divided, then the subjacent tissues, the suspensory ligaments, and corpora cavernosa;

the urethra is next cut through transversely, opposite the base of the V, its inferior surface dissected free from all the exposed tissues, and its edges are afterwards sutured to those of the cutaneous wound; lastly, the penis is cut through opposite the point where the urethra was divided, and the chief vessels closed by means of ligatures or forceps. A preferable method, so far as checking hæmorrhage is concerned, consists in applying an elastic ligature opposite the base of the wound, and amputating the penis an inch or so below.

The procedure is as follows :—

The animal having been cast on the left side, the right hind limb is lifted, carried forward, and fixed to the corresponding forearm,



FIG. 439.—Amputation of the penis by the elastic ligature.

as in castration; the penis is disinfected, together with the posterior abdominal and scrotal regions.

Having introduced a catheter into the urethra for a distance of 10 to 12 inches, an assistant covers the free portion of the penis with a cloth, and draws it gently forwards. Another assistant, placed behind the patient, draws the skin covering the base of the penis towards the perineum. A ligature is then applied to the base of the penis.

A little above the point where amputation is to be performed two lines, starting from above the urethra and diverging towards their free ends (an inverted V in fact), are traced on the inferior surface of the penis, the extremities being about $1\frac{1}{4}$ to $1\frac{1}{2}$ inches apart. The base of these incisions is united by a transverse incision, and the triangle of skin thus delimited is removed. The subjacent tissues

are then excised, layer by layer, over the space covered by this wound until the urethra is exposed. This is opened at the lower margin of the wound by a transverse section. The catheter is then removed, and a grooved director passed into the exposed end of the divided urethra, the groove being directed towards the lower surface of the tube, and the urethra is divided with the bistoury along its middle line throughout the entire length of the part exposed. It is next divided transversely, and each flap of the mucous membrane of the urethra united to the corresponding flap of the integument of the penis by silk sutures. The operation is completed by applying just at the base of the wound, four or five turns of a tightly-

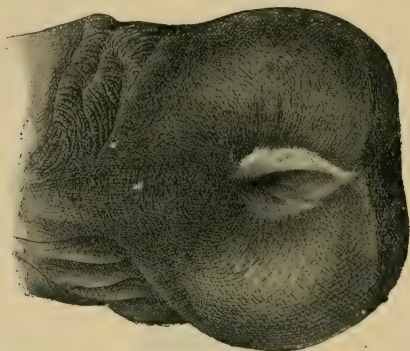


FIG. 440.—Amputation of the penis showing stump and urethral orifice.

stretched rubber cord. The ends of the cord are fastened together, and the penis divided an inch or so below by a single cut (Fig. 439).

With the method referred to a mass of dead tissue remains for several days adherent to the end of the penis. Any risk of infection is prevented by antiseptic irrigation. The dead mass and ligature fall away between the sixth and tenth days. The stump is then usually much tumefied, but the swelling and œdema rapidly diminish. The wound suppurates little. A layer of granulations soon covers it, becomes hard, and contracts, gradually drawing the skin over the stump until towards the end of the third month, the cicatrix is comparatively small. As for the muco-cutaneous wound, when the sutures hold, and the mucous membrane does not cut through, the apposed edges rapidly unite. Most frequently, however, the mucous membrane cuts through at one or more points and becomes separated from the integument; vegetations occur on the exposed

tissues, often becoming so abundant as partially to obstruct the meatus. There is, however, no cause for alarm. Excessive granulation soon ceases, the parts heal; like the wound on the extremity of the penis, cicatricial contraction results in drawing the mucous membrane towards the skin, and the urethral opening resumes and permanently preserves the shape given to it by the operator. In both cases the final result is the same; when the surgeon has done his part well, patency of the urethral opening is ensured. As soon as inflammatory symptoms disappear, the animal stales with the same ease as any other horse.

Of five cases operated on in the Alfort clinique, during a period of two years, not one showed after-contraction; and in those treated between 1890 and 1895 the results—except for hæmorrhage—were not less satisfactory.

A case of necrosis of the penis in the dog, successfully treated by operation, is described in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery," p. 409. For cases in the horse, see p. 411, 412, and 413 *loc. cit.*

In dogs, amputation can be effected either behind the os penis by using the knife or écraseur, or the bone can be sawn through. After the latter method strictures and closure of the urethra are certainly commoner, though amputation behind the os penis by ligaturing blood-vessels, and exposing and sewing the urethra to the neighbouring parts, and amputation by sawing through the os penis, have been equally successful. A dog operated on in the latter manner died a year later from disease of the bladder. On post-mortem, the stump was found cicatrised without any considerable stricture of the urethra. After-treatment is in all methods the same, and consists in washing or syringing out the sheath with disinfecting fluids.

IV.—TUMOURS OF THE SHEATH AND PENIS.

FIBROMATA (warts) are often seen on the horse's sheath; according to Möller's experience, carcinomata also occur here, and melanosarcomata and melano-carcinomata have been reported. Piovesau removed a fibro-sarcoma as large as a child's head from a stallion's sheath. Warts occur on the prepuce of the dog and of other animals, not infrequently in great numbers. They are generally situated on the inner folds, but frequently on the penis also. Whether condylomata occur here, as Bayer believes, seems questionable.

The simultaneous appearance of warts on the mouth does not prove the specific nature of the new growths, because warts are also

frequent about the lips. Cadiot removed a large papilloma weighing 12 lbs. from the glans penis of a dog by amputating the penis itself with an elastic ligature. Francesco used the *écraseur* to remove an ulcerating angioma. Fellenberg saw a "knobby" swelling on the penis of the dog; Rubinski found in this situation cancer in geldings; Laurent a melanoma weighing about 50 lbs. in a horse; Johne and Eber primary tuberculosis in an ox. Schwenk removed a papilloma from the glans of a stallion; it had interfered with copulation.

The significance of these conditions depends chiefly on their nature and extent, which require to be carefully considered in delivering a prognosis. Tumours on the prepuce rapidly produce stenosis and phymosis or paraphymosis; they may also press on the urethra, or attack its walls and impede urination, whilst malignant tumours lead to disseminated secondary growths.

Treatment. Pedunculated warts are snipped off with scissors, any slight bleeding being checked with the cautery or with lunar caustic, which at the same time tends to prevent reproduction. Large pedunculated tumours may be ligatured or removed with the *écraseur*. The elastic ligature is also recommended. Warts and benign tumours with broad bases may, unless very large, be destroyed by an irritant such as chromic, nitric, or sulphuric acid; the larger, and particularly those suspected to be malignant, are better excised. Malignant growths on the penis may necessitate amputation, to save the animal or to render it capable of work for some time.

V.—DISEASES OF THE PROSTATE.

IN the horse the prostate gland consists of two lobes about 3 inches long and 2 broad. The gland is little developed in oxen and swine, but is large in carnivora, in which it appears to surround the urethra. In animals disease of this gland is much rarer than in man, but both acute inflammation and abscesses occur, and chronic thickening, with formation of new growths, has been seen in dogs. The first clearly results from inflammation spreading from the urethra. Haubner opened an abscess in the gland through the urinary passages; Reinemann (in a steer) operated from the anus. Bang saw acute prostatitis in the horse; Frauenholz tuberculosis of the gland in oxen.

Hypertrophy of the prostate, which often occurs in elderly people, and consists of hypertrophy of glandular and increase of connective tissue, is, amongst animals, almost entirely confined to dogs, and

even in them is seldom seen ; Forster has, however, examined several cases of the kind. Sickert made the post-mortem of a horse in which the prostate weighed $2\frac{1}{2}$ lbs. Tumours are common in the prostate ; Cadiot found cancer.

In sheep, Gurlt described a so-called prostatic calculus, consisting partly of a precipitate from the secretion of the gland, partly of gravel from the bladder.

The gravity of these conditions depends on the fact that the urethra is compressed and urination rendered difficult. Acute inflammation may extend to the urinary passages, cause disease of the urethra and bladder, and prove fatal from pyelonephritis.

Symptoms and progress. Difficulty in defæcation and urination first directs attention to the disease. The animals strain, sometimes without result, sometimes with the discharge of urine in a thin stream or in drops, sometimes urine is discharged involuntarily. If in dogs thus suffering urethral calculus is absent, a rectal examination must be made, when the swollen prostate will be felt close behind the bladder. When acutely inflamed, the swelling is soft and painful, but in chronic conditions it is hard and painless. Prostatic calculi sometimes cause the gland to feel almost like a shot-pouch. Abscesses occasionally discharge into the urinary passages under the pressure of the finger. Haubner examined a dog in which the prostate gland was as large as a hen's egg ; pressure caused the discharge of a purulent, ill-smelling fluid through the urethra, after which recovery occurred ; but in the case noted by Reinemann in a steer the animal died from cystitis.

Hypertrophy of the prostate and tumours generally cause death by interfering with urination, or they may necessitate slaughter of the animal. Linéaux saw cases of hypertrophy of the prostate in dogs ; in one there was intermittent bleeding and difficulty in urination ; in the other these symptoms were accompanied by secondary cystitis and hydronephrosis. Both cases ended fatally. A third case was complicated with perineal hernia ; this also died.

Treatment. In acute cases, laxatives and clysters remove the pressure on the urethra resulting from a distended rectum. Abscesses in the gland can be evacuated through the rectum. Disinfectant fluids may be injected through the catheter. In chronic disease in man extirpation has been practised. Castration was warmly recommended as a cure for enlarged prostate in man by White, of Philadelphia. A number of cases were operated on with marked success, cases where the catheter had been used for years showing immediate improvement, and patients being able to urinate without

assistance in five days after operation. Removal of the enlarged prostate has been attempted in the dog, but the results have not been satisfactory. Probably enucleation of the gland substance, taking care to lacerate the capsule as little as possible, may eventually prove successful.

R. H. Clarke operated on an eight year old bull dog, in which the prostate had become enlarged to the size of a billiard ball, a portion as large as a walnut being ossified. The symptoms consisted chiefly in straining as if to pass fæces, and were only marked for three months before death. Mr. Clarke purposed forming a perineal fistula, but as the conditions appeared unfavourable when operation was advanced, the dog was killed with chloroform. The description of symptoms, treatment, and especially of the post-mortem examination and microscopical appearances of the growth, are fully given in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery."

VI.—DISEASES OF THE SCROTUM.

(a) APART from those caused by operative interference, injuries, wounds and bruises are comparatively rare in animals, in consequence of the sheltered position of the scrotum. In dogs, however, the scrotum is sometimes bitten, and injuries may be caused in other animals by fragments of glass and wood, and, during attempts to jump hedges, by thorns. In horses the scrotum is sometimes injured by the carriage-pole, and decubital necrosis readily occurs in dogs after lying long in one position, as during paraplegia or distemper. In delivering a prognosis, it should be particularly noted whether or not the injuries are of a penetrating character, and have affected the testicle. By penetrating wounds are meant those which extend to the tunica vaginalis or peritoneal cavity. But even in penetrating wounds the prognosis and chance of recovery are favourable, provided there is no diffuse peritonitis, though the testicle can seldom be saved, on account of the danger of infection extending to the peritoneum. Severe bruises and injuries followed by extensive necrosis must be viewed as dangerous. Superficial wounds, on the other hand, generally heal readily.

Treatment. The parts are first thoroughly cleansed, and then carefully examined, to determine the area of the injury. If the testicle is to be saved, strict antiseptic treatment will be required. In large animals the suspensory bandage already described should be used. In deep wounds penetrating the tunica vaginalis, pus formation and peritonitis are likely to ensue unless the parts are

at once rendered aseptic. Castration is often necessary, and in such case the scrotum should be freely divided to give free exit to discharge, and the usual principles are followed. Superficial injuries are treated like similar wounds in other parts.

(b) Inflammation of the scrotum occurs in northern countries, from travelling bulls in snow-drifts. On reaching the stable the skin of the scrotum becomes red and swollen, and the folds disappear. Exudation soon sets in, and superficial necrosis of the skin may take place.

Though the course of the disease is almost always unfavourable, yet at times a troublesome eczema remains, which bids defiance to treatment, especially when the discharge is profuse. When large areas of the scrotal skin have sloughed, cicatrisation occurs with difficulty.

In dogs an acute eczema sometimes extends over the entire scrotum, and is characterised by swelling, reddening of the skin, exudation, pain or itchiness, causing the animals continually to lick the parts, and thus interfere with treatment and healing. The swelling sometimes causes a peculiar straddling gait.

Treatment of frost-bite of the scrotum consists in bathing the parts with disinfectants and applying dry dressings. Wheat flour, tannic acid, and tannic acid with iodoform are all useful. In eczema the dressing may consist of tannin and iodoform, followed by an application of aloes and tar which will prevent the animal licking the diseased spot. When exudation is not excessive, the parts may with advantage be brushed over with iodoform collodion; cocaine might also be tried.

(c) **New growths** are not infrequent in the skin of the scrotum. Rosenbaum found a swelling on the scrotum of a steer, and Eberhardt describes a tumour nearly 16 inches in length in an eighteen months bull. The nature of these new growths cannot, however, be ascertained from the description given. Fröhner cured a case of botryomycosis of the scrotum in a horse by operation. Varicose conditions of the scrotum in dogs (diffuse dilatation of the veins) have been described, attended with ulceration, profuse bleeding, and a tendency to recur.

In dogs, a pendulous condition of the scrotum with failure to retract the testicles when the scrotum is grasped is a grave symptom seen near the termination of severe internal diseases, and may sometimes be observed in aged animals.

The treatment is almost self-evident. New growths, unless possessing too broad a base and extending to the tunica vaginalis,

are generally easily removable. The mobility of the tumour gives sufficient indication on this point. If needful, the entire scrotum can be removed along with the testicles without danger, as the primitive methods of castrating ruminants clearly show.

Various parasites, which also occur in the peritoneal cavity, are seen in the scrotum and tunica vaginalis, such as *Sclerostomum armatum*, *Filaria papillosa*, &c. They have no particular significance, and are accidentally encountered in castration or when making post-mortems.

VII.—INFLAMMATION OF THE TESTICLE AND EPIDIDYMIS. ORCHITIS, PERIORCHITIS, EPIDIDYMITIS.

INFLAMMATION of the testicle is certainly not frequent, though it has been seen in different animals. Inflammation of the epididymis, common in man during gonorrhœa, is seldom seen in animals.

Orchitis results from external violence, from bruises and injuries, sometimes from inflammation extending from the urinary passages to the spermatic ducts, and thence to the testicles; metastatic inflammation of the testicle is met with in pyæmia, glanders, &c. Walraff insists on having seen enzootic orchitis with abscess formation in horses and oxen, but nothing specific is known of its cause. Ludwig found in a horse suffering from brain mischief abscess of both testicles; Knese saw a similar affection in pigs. Caseous nodules have been found in the testicles of tuberculous horses. Hess describes a case of tuberculosis of the epididymis in a breeding bull. The end of the epididymis formed a swelling as large as a goose's egg, which was distinctly divided from the testicle by a circular depression.

Symptoms and progress. The first symptom consists in swelling, sometimes slow, sometimes rapid, but always very painful, especially in acute inflammation; the gait is, therefore, often straddling, and sometimes the pain produces symptoms of colic. The scrotum escapes as long as the tunica vaginalis remains intact, but, if periorchitis also occur, œdema of the scrotum sets in. Infective orchitis is always accompanied by fever.

Aseptic inflammation of the testicle resulting from bruising generally takes a favourable course. Bleeding may certainly occur, and produce hæmatocele, but generally blood is readily absorbed, and normal function restored. But that form of orchitis conveyed through the medium of the urinary organs or produced metastatically often produces pus formation or necrosis. The testicle is especially

prone to necrosis, as is seen after subcutaneous ligation of the spermatic cord for castration. In ruminants and horses, calcification and ossification of the testicle have also been seen. These processes, however, are not dangerous to life in the same degree as pus formation, which readily extends to the spermatic cord and produces fatal purulent peritonitis. The commonest result is periorchitis, adhesion of the testicle to the tunica vaginalis, or perforation outwardly through the skin of the scrotum. Hess saw periorchitis plastica hæmorrhagica in a sucking-pig and in a stud bull. Periorchitis often results in hydrocele or hæmatocele.

Treatment. Rest is very necessary, especially if serious swelling interferes with the animal's movements. In such cases a suspensory bandage may be applied. In fresh traumatic orchitis, applications of cold water, solution of acetate of lead, or similar fluids may be made. In human medicine, orchitis is treated by compresses of adhesive plaster, which may be tried in larger animals, or in dogs can be replaced by painting the scrotum with collodion and applying a suspensory bandage. Scarification, though often condemned, is of considerable value in certain cases; the punctures should be deep, and bleeding should be promoted. Afterwards, the scrotum is dressed antiseptically and supported by a bandage or by adhesive strapping. Castration may certainly appear indicated, especially in infective orchitis, with simultaneous disease of the spermatic cord. Should signs of abscess formation appear in the scrotum, an incision must be made; and if high fever, &c., result, castration should be performed in the usual way. As far as possible, any diseased portions of spermatic cord should be removed. Hertwig has seen recovery from spontaneous orchitis in the horse after low diet, withdrawal of blood, and the use of laxatives.

VIII.—TUMOURS OF THE TESTICLE (SARCOCELE) AND OF THE EPIDIDYMIS.

SINCE olden times every abnormal swelling of the testicle has been termed sarcocele. In swine and cattle tuberculous growths occur in the testicle; in horses sarcomata, carcinomata, myomata, botryomycomata, dermoid cysts, with hair and teeth, have been met with, and in dogs both sarcomata and carcinomata. Hess saw tuberculosis of the epididymis in a bull; the end of the epididymis formed a swelling as large as a goose's egg, and was divided from the testicle by a distinct furrow. Schmidt saw tuberculosis of both testicles in a bull; Arens in a boar; the scrotum

showed numerous fistulous openings communicating with abscesses containing caseous pus; the two testicles weighed nearly 20 lbs. The horse's testicle, affected with medullary cancer, which Puntigam described, weighed 13 lbs.

Symptoms and course. One or both testicles slowly increase in size, the swelling appearing painless. Sometimes the surface of the testicle retains its smooth character, sometimes it appears lobulated or knotted. The swelling may become very considerable; at Alfort a horse was seen that had a testicle weighing 20 lbs.

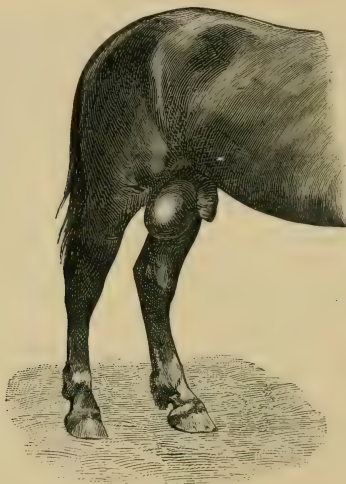


FIG. 441.—Carcinoma of the testicle in a horse. (After photograph.)

Malignant new growths often spread to the spermatic cord, causing it to swell and become hard, uneven, or lobulated. Where carcinomata exist, the lymph glands of the lumbar region also become swollen, and in the case of carcinoma of the testicle shown in Fig. 441 they were so greatly enlarged as almost to prevent the hand passing into the abdominal cavity. Provided new growths remain confined to the testicle, recovery follows castration, which, so long as it still appears practicable, should not be delayed if the swelling rapidly increases, even if the spermatic cord is already affected.

Treatment. In such cases castration is the only resort, and even where the growths are of a benign character it is to be recommended if they have attained a large size. As the spermatic

vessels are often abnormally dilated, clams should be used, as they most surely prevent bleeding. If, however, the upper part of the spermatic cord be much diseased, the application of clams is sometimes impossible, and it is better to ligature the cord with strong silk or catgut, and allow the ligatures to hang from the wound, removing them after 10 or 15 days. Should the new growth have already reached the abdominal cavity, the patient, if a horse, may be worked until advancing disease renders it useless, or if an ox, prepared for slaughter.

IX.—HYDROCELE, HÆMATOCELE, AND VARICOCELE.

DROPSY of the tunica vaginalis is known as hydrocele, *i.e.*, a watery swelling. Instead of the few drops of fluid usually present, one finds large quantities of serum between the parietal and visceral layers of the tunica vaginalis. The condition, therefore, in its nature resembles hydrops, and may result from inflammation of the tunica vaginalis. Sometimes the fluid accumulates in the spermatic cord, and then lies between the folds of the tunica vaginalis propria, a condition which has been termed spermatocele.

Both conditions have repeatedly been seen in horses, bulls, and rams. Steiner found spermatocele in young geldings; the serous fluid was contained in several small sacculations. Richter has described the same disease in goats and horses. Möller met with hydrocele of the spermatic cord containing more than 16 ounces of a reddish serum in castrating a cryptorchid. This complicated the operation and rendered it much more difficult, but nevertheless it succeeded. Steffen saw hydrocele of the tunica vaginalis in a ram; Puntigam noted dilatation of the lymph vessels of the spermatic cord.

Causes. Hydrocele may result from inflammation of the tunica vaginalis of the testicle or of the spermatic cord, and may take either an acute or chronic course. In a sucking-pig and a stud bull Hess found not only serum, but fibrin and blood in the tunica vaginalis. External injuries, like bruises, are doubtless sometimes responsible for disease of this character. When they lead to severe bleeding from the spermatic cord or tunica vaginalis, the condition is called hæmatocele. Hydrocele of the tunica vaginalis occurs in connection with hydrops ascites and hydrothorax as a local symptom of the general dropsical condition. Martin concluded that the occurrence of *filaria papillosa* in the dropsical vaginal tunic was a cause of hydrocele, but this view cannot be upheld, as the parasite is

seen in by far the greater number of cases unaccompanied by hydrocele.

Symptoms. Hydrocele with hæmatocele of the tunica vaginalis sometimes presents a striking resemblance to inguinal hernia. The swelling is often very marked (Steffen saw a goat in which the scrotum reached nearly to the ground), but is soft, elastic, often painless and free from inflammatory symptoms. The condition is distinguished from rupture by the fact that swelling is confined principally to the lower part of the scrotum; above, the scrotum tapers away and shows no abnormal distension, because the fluid is easily displaced. By compressing the upper part of the scrotum fluctuation may easily be detected at the base.

In large animals the presence of inguinal hernia can also be determined by examination per anum. In hydrocele of the spermatic cord such examination may be necessary to confirm the diagnosis, as the form of the swelling often greatly resembles that of a hernia. If absolutely necessary, an exploring needle may be passed into the scrotum.

This disease is distinguished from sarcocele by the less firm swelling, and by the smaller size of the testicle, which as a rule appears atrophied.

Prognosis is favourable in as much as life is not threatened, but recovery with conservation of the testicle is generally doubtful. Early treatment of hæmatocele and hydrocele is often successful; complication with inguinal hernia renders the condition grave.

Treatment. Velpeau was the first to employ injections of iodine for hydrocele, and they are still used in man. Simple puncture seldom succeeds. Stephen emptied the tunica vaginalis of a ram fourteen times, but it always filled anew; nor was puncture with injection of iodine solution more successful. Antiseptic precautions must, of course, be observed. When employing this method, the tincture of iodine should be freshly prepared, the tunica vaginalis emptied of its contents, and the solution injected and allowed to remain; afterwards a suspensory bandage with antiseptic packing should be applied to the scrotum. Great swelling follows, but subsides after six to eight days.

Castration is more certain if the diseased portions of the spermatic cord be removed with the testicles; if properly performed, healing generally results. Operation must, however, be delayed until acute inflammatory symptoms have subsided. In castrating four sucking-pigs affected with periorchitis and hydrocele, Hess lost two; it was remarkable that of five of a litter, four suffered from hydrocele.

Varicocele, or cirsocele, consists in dilatation of the veins of the spermatic cord. It is commonest in old animals, but only exceptionally calls for treatment; it is usually only discovered on castration, and even then requires no particular precautions. Aneurysmal varix has been observed in bulls. The dilatation of the plexus pampiniformis associated with varicocele, is sometimes so marked that the scrotum appears as much enlarged as in hydrocele, or in inguinal hernia. Aneurysmal varix is sometimes denoted by pulsation in the scrotum, or the passage of blood under the skin may be felt; both symptoms disappear, however, immediately the scrotum is compressed above; Meyer was able to feel the artery. Castration is the only treatment, and care is required to prevent rupture of the greatly distended vessels; the vessels may be ligatured with stout silk, or clamps may be applied.

X.—INFLAMMATION OF THE SPERMATIC CORD. SCIRRHOUS CORD. FUNICULITIS CHRONICA.

ON account of its sheltered position the spermatic cord rarely becomes inflamed, unless the scrotum be opened, though bruising or hyper-extension may produce acute inflammation and hæmatocele. It has already been stated that chronic inflammation may occasion hydrocele. But none of these diseases compare in frequency with scirrhus cord, a condition due to infection of the cord after castration. In horses it is comparatively common, and in oxen by no means unknown.

A portion of the cord is removed in castration, and the remainder then swells, partly in consequence of disturbed circulation, partly of inflammatory irritation. This swollen condition generally disappears completely in eight to fourteen days, sometimes a little later. In horses, and occasionally in oxen and other animals, owing to infection of the wound, the swelling increases, and the stump of the spermatic cord may become as large as a man's head. The enlargement may be confined to the extremity, but generally extends further upwards, even beyond the inguinal canal and into the abdominal cavity. Ringk noticed an extraordinary development in a horse, the left spermatic cord on post-mortem weighing 24 lbs. and the right 30 lbs. In such cases the operative wound refuses to heal; a slight opening remains, from which small quantities of pus are discharged, and through which a probe can be introduced for a distance of 4 to 8 inches into the spermatic cord.

It was long known that the disease was due to chronic inflammation

of the spermatic cord, though its true cause was not suspected until Rivolta, in 1871, suggested that it consisted in infection with microparasites, and later investigations have established that the great majority of cases of scirrhus cord are due to botryomycotic funiculitis.

The scirrhus cords removed in the Berlin clinique were generally found to contain botryomyces and staphylococci. Sometimes the growth and thickening occur rapidly, and the spermatic cord may attain the diameter of a goose's egg in a few months; sometimes the condition may exist for indefinite periods without marked increase of size.

Scirrhus cord is commoner in certain districts, perhaps because the necessary conditions for infection are more favourable; perhaps because the method of castration there adopted favours infection.

The following contributing causes of scirrhus cord are recognised:—

(1) Exposure of the cord after castration, and its projection beyond the tunica vaginalis or scrotal wound. Sometimes this is the result of applying clamps too low, or using too heavy clamps; pulling on the cord or violently tearing away the testicle ruptures the peritoneal folds which support the cord within the abdomen and allows the cord to protrude below the wound. Exposed to the air the cord swells, and sometimes becomes strangulated in the narrow skin incision and in the tunica vaginalis. The portion lying beyond the castration wound then begins to proliferate, and a condition results which has been described as "Champignon" or chronic funiculitis. In other cases the cord is withdrawn within the scrotum, but in consequence of infection the wound persists, giving escape to a greyish pus. The cord and tunica vaginalis are inflamed, swollen and indurated, and if not checked the inflammatory process extends upwards, frequently invading the abdominal portion of the cord.

(2) All influences favouring pyogenic infection of the operation wound promote development of scirrhus cord (Fig. 442). These comprise, too small an incision, or an incision too far to one side of the scrotum, both of which conditions impede drainage; too small a wound also favours strangulation of the cord and formation of "Champignon," as shown by Trianon's experiments. Castration by ligature is doubly dangerous if performed with unsterilised materials. The ligature often remains in position a long time, and therefore increases the danger of infection. Inflammation spreads to the inner surface of the tunica vaginalis, which soon becomes adherent to the spermatic cord; but the con-

nective tissue lying between the tunica vaginalis and the dartos is seldom affected.

Symptoms and course. The swelling of the testicular cord does not completely subside after castration, but continues to discharge pus and slowly increases in circumference. This seldom receives early attention, and expert assistance is only called for when the owner fancies the discharge has lasted too long, or when several attacks of acute cellulitis have occurred. As soon as the fistulous

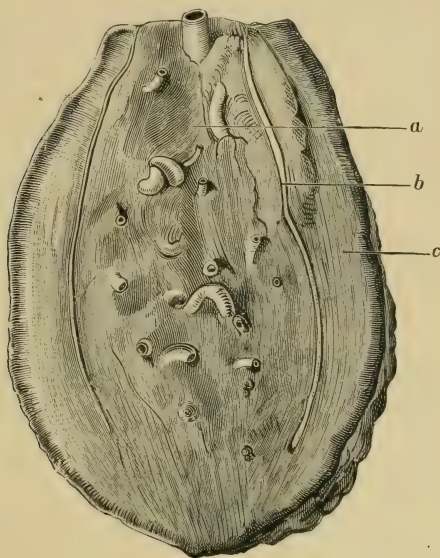


FIG. 442.—Scirrhus cord formation in the horse. *a*. Thickened spermatic cord ; *b*, tunica vaginalis ; *c*, thickening external to tunica vaginalis.

aperture has closed, the swelling suddenly increases, spreads to neighbouring tissues, including the connective tissue around the tunica vaginalis, often even to the sheath itself, and only subsides when a new opening has been established. This acute cellulitis returns at varying intervals. It may, however, never occur, and the disease exist for an indefinite time without making much progress or occasioning disturbance, indeed without ever being recognised. The swelling, which is firm, hard, and slightly painful, usually remains confined to the lower end of the spermatic cord, but sometimes extends upwards, and may even reach the abdominal

cavity. Less frequently the lower end of the cord is not attacked, and the swelling begins an inch or two above. At the point where the swelling is in contact with the skin, it is always attached to the base of the scrotum.

The fistulous opening is small and funnel-shaped, and discharges a variable quantity of pus; a probe can be passed 2 to 4 inches into it.

Cadiot and Dollar ("Clinical Veterinary Medicine and Surgery") describe a case of deep-seated inguinal abscess after castration. The condition simulated scirrhus cord. There was diffuse induration in the left inguinal region, extending over the abdomen beyond the sheath. The horse showed fever and was lame on the left leg, which was abducted during movement. Examination *per rectum* revealed in the prepubic region, opposite the left inguinal ring, a diffuse, rounded, smooth swelling, which was diagnosed as an abscess. The animal was cast, the inguinal canal examined, and a large abscess containing two quarts of pus was opened. By drainage and antiseptic dressing the abscess cavity closed so far that five weeks after operation the horse was able to return home.

In another case described by the above writers, the growth, by pressing on the infero-lateral surface of the penis, caused difficulty in micturition. Extirpation was followed by recovery.

Prognosis. As cure depends on complete excision, it is necessary to ascertain whether operation is possible, how far the cord is diseased, and then whether all diseased parts can be removed. Extension of the disease into the abdominal cavity renders the condition incurable. Examination from without and from the rectum will determine the dimensions of the growth; of 100 cases submitted to Möller, all proved amenable to treatment.

Treatment. Preventive measures are of great importance. Antiseptics should be freely used before and after castration; clams should be properly shaped, and, in applying them, the posterior part of the cord should not be cut through; ligatures if used should be sterilised. After removing the clams, the spermatic cords should be completely returned to the tunica vaginalis, and escape of discharges promoted by exercising the animal.

When inflammation has become chronic, neither potassium iodide internally, iodine injections, setons dressed with sublimate, nor the use of the actual cautery, commonly succeed, though where operation is impossible they may be tried. Sublimate setons and the cautery are perhaps more efficient than injections; but when the spermatic cord is extensively diseased, removal of the diseased part is alone useful. Though the period of acute cellulitis must be avoided, there should be no hesitation in performing the operation,

which is simple, and, if precautions against bleeding are taken, not dangerous.

The horse is cast, the feet of the affected side fastened together, and the animal placed on its back. The operator then kneels behind it. The seat of operation is cleansed, and an elliptical piece of skin, sufficiently large to allow of the growth passing easily through the opening, removed with the knife. Any skin adherent to the growth must also be taken away, and care taken to provide for drainage.

A tape, passed through the subcutis of the isolated piece of skin and through the growth, is held by an assistant, who pulls gently on the spermatic cord. The operator now breaks down the tissues surrounding the diseased cord, which is covered by the tunica vaginalis. Any bleeding vessels are at once ligatured. The cord must be exposed if possible beyond the diseased part, or, in cases where the disease extends within the abdomen, as far as the external inguinal opening. When the growth is small the tunica vaginalis must be exposed at least as far as it is adherent to the spermatic cord, and, if a clam is to be applied over it, up to the highest point the disease has attained. This method is preferable, and as soon as the upper limit of the growth is reached, a strong ligature or clam is applied over the spermatic cord and tunica vaginalis. One then proceeds as in castration, by the covered method. In dealing with extensive growths, a short clam, which can be introduced into the operative wound, should be applied to the cord, so that, after removal of the diseased part, it may remain, as in the operation for inguinal hernia (which see).

Where the disease extends so far upwards as to prove beyond easy reach, the tunica vaginalis is divided where it seems movable over the swelling; the spermatic cord can then be drawn down, and the clam applied above the diseased portion. In other cases a ligature or the *écraseur* may be used. It is best to tranfix the cord with a stout ligature, tying it as tightly as possible, and allowing the ends to hang below the skin wound, so that it may be removed if it does not fall away of itself. The elastic ligature is also valuable. Carefully used, the *écraseur* and the torsion method also prevent bleeding. To prevent post-operative hæmorrhage, the wound, when cleansed, is powdered with iodoform-tannin and stuffed with carbolised jute, a few sutures being inserted to retain the tampons in position.

Dressing and clam remain in position for at least forty-eight hours; on removing them, the parts are washed out with sublimate or carbolic solution, again powdered with iodoform-tannin and

treated as an open wound. Daily exercise favours drainage. Recovery generally occurs in fourteen days to a month, without complications.

If the new growth has spread outwards beyond the tunica vaginalis, the subcutaneous connective tissue, which is infiltrated with small abscesses, must, as far as possible, be removed. Any remaining abscesses or sinuses should be scraped out with the curette, or dressed with concentrated solution of chloride of zinc.

Malkmus has recently proposed a modification of this procedure. Starting from a spot, if possible behind the growth, he breaks through the tissues in the direction of the inguinal canal with the fingers, in order, from that point, to destroy the adhesions of the growth to surrounding parts. The most resistant portions of connective tissue are divided by the knife or scissors, blood-vessels being, if necessary, ligatured. For dividing the spermatic cord he uses a special *écraseur* with a very strong chain.

New growths of the spermatic cord outside the vaginal tunic can sometimes be removed by ligature and caustics. It is often possible to cut through the growth with a ligature or to scrape it away with the finger, though this is not satisfactory unless the cause *i.e.*, the strangulation of the cord by the scrotum or tunica vaginalis, be at the same time remedied. Fig. 442 shows a growth which was removed by ligature three months after castration. As a rule, however, it is best to remove the lower end of the spermatic cord in the manner above described, otherwise the scirrhus growth almost always extends. Degive passes a metal rod through the swelling after the *écraseur* has almost cut through the spermatic cord, turns that portion of the cord lying within the *écraseur* chain once or twice around its axis, and then completes the operation.

When the morbid growth extends as far as the inguinal ring or into the abdomen, the inguinal canal may be dilated and the chain of the *écraseur* passed even into the abdominal cavity. Dollar has successfully operated on several cases of scirrhus cord extending as far as the inguinal ring, using the *écraseur*. He has never had bad results or troublesome bleeding, the secret of success being to observe all possible antiseptic precautions and to divide the cord very slowly. Cases are on record of growths weighing as much as 120 lbs. Necessarily they could not be removed.

Soon after potassium iodide had been proved efficacious in actinomycosis it was tested in the treatment of scirrhus cord. The recorded results have been conflicting, probably because the organisms producing the changes may not be the same in every case, and also

because simple funiculitis occurring soon after castration may have been mistaken for the essentially chronic disease in question. In support of the first contention it may be noted that some observers have found scirrhus cord due to malignant growths like sarcoma. Fröhner records two cases, one of which received 10 ounces of potassium iodide *per os* and $6\frac{1}{2}$ ounces of sodium iodide intratracheally, the other nearly 25 ounces of iodide of potassium *per os* within a few weeks. Neither showed any improvement. The first horse had to be killed. The second was operated on, and recovered sufficiently in three weeks to return home. In seven weeks from operation recovery was complete. In some instances, however, the iodide treatment has arrested the growth, and there can be no objection to a further trial, particularly in the early stages of the disease.

DISEASES OF THE FEMALE ORGANS OF GENERATION.

As the greater number of these diseases are considered in works on special pathology and obstetrics, only a short account of those which necessitate surgical interference is here given.

I.—INJURIES AND INFLAMMATION OF THE VULVA, VAGINA, AND UTERUS.

IN cows, the labia pudendi are most frequently injured by horn-thrusts; in mares, occasionally, by the shafts of vehicles; in all species of animals by violent and unskilful manipulations during delivery. In such cases rupture of the perineum is common. In cows, the vagina is sometimes wounded, though seldom seriously, by the application of the vaginal truss for the purpose of retaining the prolapsed vagina or uterus; sometimes, however, severe croupous inflammation results, and extends forwards. These conditions seldom require surgical interference, and must be treated on general principles. Sometimes wounds require extending to allow of better drainage; sometimes healing can be assisted by carefully applied stitches. Wounds in this region most frequently result from rupture of the perineum. When fresh they should be accurately sutured; when of old standing the edges may require to be freshened.

Extensive wounds and excoriations of the mucous membrane of the labia pudendi may lead to occlusion of the vulva. *Apropos* of this, the following case may be quoted:—An eighteen months filly exhibited occlusion of the vulva from its upper angle as far almost as the clitoris, where an opening the size of a goose-quill remained, from which urine was discharged in a thin stream. The adhesion was divided; but as it recurred several times, it was found necessary to pass the hand into the vagina daily and dilate the vulva. Under this treatment perfect recovery occurred.

Occlusion of the vagina, due either to persistence of the hymen or to adhesion of the surfaces of a vaginal wound, has been seen in the cow and mare. In either case the os uteri is not attainable, and a muco-sanguineous fluid collects behind the obstruction. Occlusion from imperforate hymen is of little consequence, as it can

readily be cured, but extensive union between the opposed vaginal walls is a serious matter.

A case of the former kind in an Ayrshire quey was cured by incision. The animal had shown a temperature of 104.5°F. , and severe abdominal pain. Four pints of offensive fluid were evacuated. (Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery," p. 424.)

Geyer noticed occlusion of the vagina in three calves two or three weeks after birth; in two cases it was possible to break down the adhesions. After the discharge of several quarts of a reddish, turbid, ill-smelling fluid, Geyer washed out the vagina with 1 per cent. creolin solution; recovery followed. In the third calf the entrance to the vagina was too narrow to admit even a single finger. After repeatedly passing the trocar, the animal was fattened for slaughter.

Schmidt describes a case in a heifer which eight days previously had been bulled, and had immediately bled freely; the vagina was closed by a membrane in front of the opening of the urethra. Excessive dilatation of the vagina rendered the passage of fæces difficult. After perforating the membrane with a trocar, increasing the opening with the finger and hand, and washing out the parts with creolin solution, healing occurred in fourteen days. In this case also four to five quarts of a whitish, ill-smelling fluid were discharged. The hymen was probably unusually resistant.

Wounds of the vagina in cows are commonest after prolapse or after parturition, especially in primiparæ. Sometimes the surface alone is injured or the mucous membrane excoriated, though lacerations and perforations are also seen, particularly in the large animals. More than one observer has seen perforating wounds of the vagina caused by the penis of the stallion during coitus. It must be remembered in these cases that the hinder part of the vagina is surrounded by loose connective tissue, which connects it above with the rectum and below with the pelvis. In the mare, this connection extends about 5 inches in a forward direction, and below for a rather longer distance. Perforating vaginal wounds, therefore, lie farther forward, and must always be regarded as serious, both on account of the danger of peritonitis and of prolapse of the bowel. In mares, peritonitis is most to be feared. Prolapse of the bowel is particularly favoured by straining, which is almost always present after such injuries, and by the entrance into the peritoneal cavity of air, which sometimes causes very great distension.

Hæmorrhage is less grave, unless infected blood passes through a perforating wound into the peritoneal sac, where it may lead to peritonitis. Surface injuries require attention only in mares, in which infective substances readily initiate such disease as metritis. After parturition, the danger is greater in summer than in winter, particularly if the after-birth is long retained. For the same reason,

wounds of the lower vaginal wall are graver than those of the upper ; but even perforating wounds generally heal without bad results, as is well shown by the results of castrating animals after Charlier's (vaginal) method.

An extremely severe injury, sometimes produced during delivery of a very large foetus, or by the fore-legs of one of ordinary size, is rupture of the upper wall of the vagina and lower wall of the rectum. Sometimes the parts are only perforated, and a recto-vaginal fistula results ; but in others the parts are torn for a distance of 10 to 12 inches from the opening of the vagina. Faeces then pass from the rectum into the vagina, setting up vaginal catarrh, which may extend to the bladder and uterus. Breeding from such animals is out of the question. The condition is not fatal, but implies such unpleasant complications as to render the animal almost worthless. For the surgical treatment of rupture of the perineum and recto-vaginal fistula, see " Perineal Hernia " and " Anal Fistula." Humbert and Beaufile cured four cases of perineal rupture by inserting double rows of tape sutures. In the most serious case the vulva, anus, and recto-vaginal septum were implicated.

The treatment of non-perforating vaginal wounds, especially those contracted in labour, requires particular care in animals. The foetal membranes must be removed as soon as possible, and the vagina and uterus repeatedly washed out with lysol, carbolic, or alum solution ; in mares, diluted sublimate solution (1 in 5,000) may also be employed. One of the best disinfectants is a dilute solution of iodine and potassium iodide. It has the advantage of not setting up violent expulsive efforts, as do most of the other fluids named. Injuries to the vulva or its neighbourhood should be swabbed with 10 per cent. solution of chloride of zinc, so as to form an eschar, and diminish the chance of infection from the wound. It is better to avoid washing out perforating wounds, because of the danger of thus causing peritonitis. If within reach, as when affecting prolapsed organs, such wounds may be sutured before reducing the prolapse.

Wounds of the uterus are caused, during parturition, by instruments or by the little animal's feet, and in cases of prolapse, by external violence ; rupture of the pregnant uterus has also been seen. When diseased the uterus naturally tears more readily than when healthy, and such accidents are therefore commoner after metritis. Whether, as has been stated, rupture is produced by dropsical conditions of the membranes seems doubtful ; more frequently it results from violent interference when the foetus is in an awkward position.

Buhl found the uterus of a young pregnant cow completely torn away from the vagina, and adherent to the rectum, between which and the displaced uterus a communication existed; fæces had entered the uterus, whilst the bones of the foetus were almost completely exposed by destruction of the soft parts; some had penetrated into the rectum.

Hess saw a similar case: a three year old cow which had been covered in February, did not calve by November, and was therefore fattened; in the following spring, on its being slaughtered, the neck of the uterus was found to have been ruptured, and to have again united in a globular form. The uterus containing the calf lay in the left lower flank, suspended by the broad uterine ligament. It was 20 inches in length, and weighed nearly 40 pounds. The skin already showed growth of hair, and the two nipping teeth were distinctly developed; the foetus, when separated from the uterus, was therefore about eight months old. Hess thought that torsion of the uterus was responsible for the rupture.

The principles laid down for wounds of the vagina apply equally to the prognosis and treatment of uterine injuries. As long as the cervix uteri remains closed to infection, injuries like ruptures of the uterus seldom produce grave results. Certainly they are sometimes followed by abdominal pregnancy and death during parturition, while extensive ruptures may also take a fatal course in consequence of excessive bleeding. It is quite otherwise in injuries occurring during parturition. Even slight wounds of the uterus then become grave; and in mares, perforating wounds almost always prove fatal.

The gravity of injuries to the prolapsed uterus is determined by their extent and character, and the degree of general disturbance. When colic, fever, and continuous severe straining exist, and when in carnivora vomiting occurs, little can be done, though even such cases should not be abandoned.

The prolapsed part should be carefully cleansed, bleeding checked as far as possible, any remaining after-birth removed, wounds sutured, and the organ then replaced. (See "Prolapse of the Uterus.")

Inflammation of the vagina or uterus most frequently follows parturition, and is described in works on obstetrics. Certain forms of purulent inflammation occur, however, in non-pregnant animals, especially soon after coitus, and in young cattle, and are apt to take a chronic course. Such conditions have repeatedly been described by English veterinarians. Recovery is stated rapidly to follow washing out the vagina and uterus with carbolic solution or other antiseptic fluid. In bitches fatal septic inflammation of the uterus is not infrequent immediately after parturition, and even when animals have not been pregnant.

Cases of contagious vaginitis in cattle and sheep have often been described in Germany. Martens found the disease throughout a certain district,

and believed it was spread during coitus. He recommends irrigation of the vagina with dilute acetate of alumina, which is also said to be a useful prophylactic against infection, and for this purpose is syringed into the bull's prepuce. Wilhelm gives 75 grains of salicylic acid in about $1\frac{1}{2}$ pints of linseed tea once daily, discontinuing it on the fifth or sixth day, and later repeating the course two or three times. Frick saw in cows an epizootic catarrhal disease of the vagina which was spread by coition, and was frequently followed by failure to conceive. Recovery followed vaginal irrigations with $\frac{1}{2}$ per cent. liq. alum. acet., but only after a long time.

Dieckerhoff noted a severe infectious vaginitis in cows and mares. Cows affected by it invariably perished; and though the disease was less severe in mares, some of them also died. The disease set in with fever, and the vaginal inflammation was associated with a tendency to the formation of vesicles and ulcers. A blood-stained exudation was found in the abdominal cavity on post-mortem. The disease developed after a short incubation period (twelve to twenty-four hours), and generally proved fatal in a few days. Disinfection of the vagina with carbolic or creolin solution had no visible effect. In this case also the disease must principally be combated by protective measures.

II.—PROLAPSE (INVERSION) OF THE VAGINA.

PROLAPSE of the vagina is most frequent in cows and sows, rarer in mares, ewes and bitches. It depends on displacement of the uterus backwards and stretching of its ligaments—conditions which are usual after repeated pregnancies. Vaginal prolapse has been attributed to the existence of ovarian cysts, chronic metritis, retention of fœtal membranes, and to confinement and want of exercise. It is favoured by tympanites, distension of the abdomen, continuous stall-feeding on distillers' grains, pressure of the fœtus, severe straining on the part of the animal, and particularly by standing in sloping stalls; it is seldom seen when animals are in the open. It is commonest in pregnant subjects, especially during the later period of pregnancy, though it also occurs after parturition. In pregnancy the vagina appears beyond the vulva when the animals are lying down, but disappears immediately on rising. Strictly speaking, the condition consists of eversion of the vagina, in which the upper wall is most frequently displaced. When the vagina only attains the vulval opening, a red swelling of varying size, covered with mucous membrane, appears (incomplete prolapse). Less frequently a large portion of the vagina protrudes beyond the vulva, in which case the opening of the uterus is visible in the middle of the swelling, which is about as large as a man's head, and shows, on its lower surface, the opening of the urethra. In prolapse of some duration, the surface of the mucous membrane, previously of a rose-red

colour, gradually dries, and not infrequently meets with injury from the animal lying down, or sometimes from attempts at replacement. During this time the patient often strains and frequently passes urine. Prolapse occurring after delivery seldom disappears of itself, the vagina remaining continuously displaced until it receives proper attention.

Prognosis. Incomplete prolapse is usually only of importance in breeding animals, in which it may recur after every pregnancy. Injury of the prolapse may cause inflammation of a dangerous character. In rare cases severe straining may be followed by rupture of the vagina and prolapse of bowel and bladder. This condition has oftenest been seen in mares, and is rarely curable. Under such circumstances the uterus may become prolapsed; cases of the kind have been reported in ewes, goats and sows. In the ewe the prolapsed vagina becomes excoriated from contact with the wool.

Complete prolapse is always grave in pregnant animals, because of its almost invariably interfering with parturition. Prolapse in non-pregnant animals often occasions injury and inflammation of the vagina, which reduce the production of milk and greatly lower the breeding value of the animal.

In swine, the prognosis is still more unfavourable, because of the difficulty in treatment.

Treatment. As a preventive, the animal must be placed in a proper stall, so arranged that the hind-quarters are at least as high as the fore. Most other precautions necessitate increased outlay, thus rendering their adoption out of the question. The most important is, of course, to prevent the animal breeding. Before attempting curative treatment the cause of the prolapse should be sought and if possible removed; otherwise recurrence is apt to follow reduction of the protrusion.

In reducing a complete prolapse—the incomplete form generally returns of itself—the cow is placed with the fore-limbs lower than the hind. By introducing the finger into the urethra, the bladder is first emptied, the parts then cleansed as far as possible, any existing wounds sutured, and endeavours made to return the vagina through the vulva by placing the open hand against the swelling and gradually pressing it forwards. On attaining the vulval opening, the hand should be closed without relaxing the pressure, and the prolapsed vagina thus returned to its normal position. The operator takes advantage of the intervals between straining, and retains the hand in the vagina until these efforts stop. With the arm in the vagina the operator places his closed fist against the os uteri, which he pushes

back as far as possible ; this manœuvre stretches the walls of the vagina and removes the folds.

Where the prolapse is very extensive and the parts greatly swollen it often assists reposition if the lips of the vulva are held open by assistants during the attempts to return the vagina.

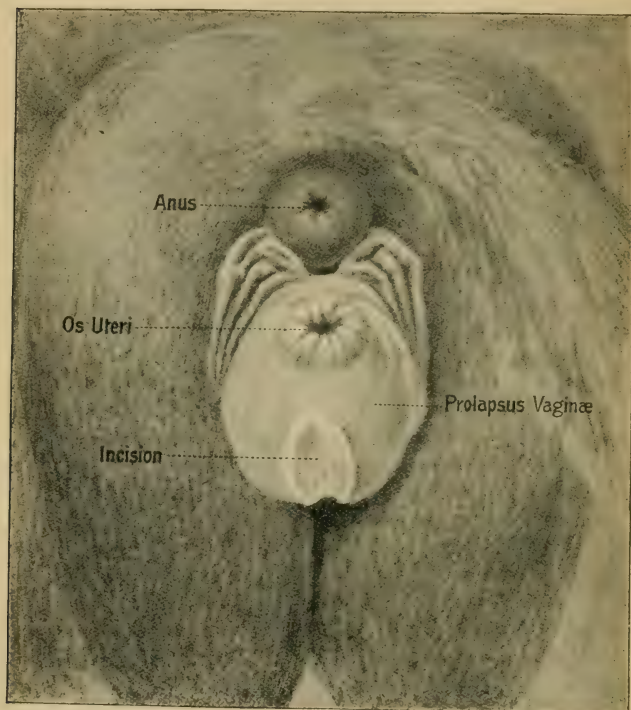


FIG. 443.—Prolapse (inversion) of the vagina.

To ensure retention in pregnant animals, trusses are employed, which partly close the vulva. Sauberg's vaginal ring is of the same character as West's clamp, though less perfect ; it consists of a metallic ring, which is passed through the lips of the vulva. When these are not available, a couple of tape sutures may be passed through the vulva. The tape must be thick enough to prevent tearing out or injuring the vagina when it is pressed forwards. In any case

a strong hold should be taken of the skin, as the lips of the vulva very readily yield.

Astringent injections are often tried, and when the prolapse is recent, they may be successful. Straining may be prevented by administering an anodyne, by injection of cocaine into the vagina, or by applying pressure to the loins.

Koepe saw a prolapse of the vagina, as large as a man's fist, in a three-year-old filly. It occurred suddenly and disappeared without treatment.

Hewetson saw the prolapse figured (Fig. 443) in a two-and-a-half year old Clydesdale mare. The vagina had several times appeared prominent previous to the actual accident. Reduction could not be effected owing to struggling, so the parts were bathed three times a day with disinfectant or astringent solutions, and on the third day they returned spontaneously. A fortnight later the prolapse again occurred. The former treatment failing, the vaginal wall was scarified. Improvement was slow, and the mare was turned out during the day. Three weeks later the wound shown was healed, and the vagina could be replaced. West's prolapse clamps were applied and left in position for a month. Recovery appeared complete.

In sows, reposition is assisted by holding up the hind-legs. The prolapsed parts are cleansed, and an attempt made, during an interval when the animal neither strains nor squeals, to thrust back the swelling. The vulva can be closed with a couple of sutures.

If the prolapsed vagina be greatly swollen, bathing with 2 to 3 per cent. solution of alum will assist reposition.

Bitches often suffer from partial prolapse of the upper wall of the vagina, which is very frequently mistaken for a tumour. A ligature can be applied to the base and the prolapsed part removed.

III.—PROLAPSE (INVERSION) OF THE UTERUS.

THIS accident, frequently seen in cows and swine, but very seldom in other animals, really consists in inversion of the uterus, the surface of the prolapsed organ appearing covered with mucous membrane. The condition, therefore, is somewhat like inversion of the bladder, but can only occur when the uterine horn is dilated or the cervix uteri is relaxed, and in consequence its occurrence is almost exclusively confined to the period immediately following parturition. Partial displacement of the uterus is certainly conceivable, even with a contracted cervix, if the extremity of one or other horn should become intussuscepted (like the finger of a glove). Though the process cannot be detected in the living animal, it probably represents the first step towards so-called prolapse, the straining it occasions finally causing displacement of the entire organ.

Such invagination may remain after prolapse if the uterus and its cornua are not completely returned. In mares, the interior portion of the displaced uterus is sometimes strangulated in the cervix uteri, generally producing a fatal issue. A similar accident has been seen in cows.

In any case, prolapse of the uterus presupposes elongation of the uterine ligaments, and therefore the factors predisposing to prolapse of the vagina predispose to this condition. They consist in too high a position of the fore-limbs, repeated pregnancy, &c.; the immediate causes are generally uterine inertia with non-occurrence of post-partum contraction, severe straining and excessive labour pains. Retention of the after-birth is one of the chief, partly because the cervix then remains open for a long time, partly because the manipulation necessary to remove the foetal membranes favours inversion. Violent interference during parturition may also give rise to it. Relaxation of the cervix is the second necessary condition; the disease is therefore rare, except soon after parturition.

Symptoms. As already remarked, incomplete prolapse, *i.e.* inversion of a portion of the uterus, is seldom directly observed, though it sometimes causes metritis and death; usually, however, it may be detected by introducing the hand into the vagina.

In complete prolapse of the uterus, a swelling, covered by mucous membrane, and similar to that in prolapsus vaginae, appears beyond the vulva. In cows, it resembles a half-filled sack; in mares, its form is more cylindrical, the organ sometimes reaches as far downwards as the hocks; the surface is not infrequently covered by the foetal membranes, but in the cow, if the membranes have already been removed, the cotyledons, which have a mushroom-like form, will be exposed. The surface gradually dries, and often becomes soiled and wounded. In swine, the prolapsed uterus is not infrequently bitten by the other occupants of the sty.

The prognosis is most favourable in cows, provided the uterus is not injured and has not been exposed more than three or four hours. Violet estimates the mortality in the mare at 68 per cent., and in the cow at 13 per cent., while of 123 cases in mares and cows, mentioned by Stockfleth, 83 recovered, 20 died and 20 were destroyed. Reposition, though certainly not easy, is yet generally possible, and if not, the animal's life can, as a rule, still be saved by amputation. In other animals, and particularly in mares, the condition is grave and often fatal. Fenner, however, saved a mare after suturing a wound about 4 inches in length, involving the mucous and muscular coats. Körner removed the uterus in a mare by ligature,

and had good results. Violent pains and delirious attacks certainly occurred, but only lasted one day. Goats and pigs have also been saved by amputation.

Not infrequently the uterus or vagina is ruptured, leading to prolapse of the bowel, in which case the animals always die unless assistance is promptly afforded, and often even when it has been given.

Treatment. The organ must first be protected from injury by applying a clean cloth. Provided the prolapsed part has undergone no great change, reposition should be attempted. The operation is assisted by placing the animal with the fore-quarters lower than the hind; but if it cannot stand, it is placed on its back, with the hind-limbs as high as possible.

Anæsthesia greatly assists reposition. Bang recommends giving the cow subcutaneously 7 to 20 grains of morphine, and a dose of 6 to 10 drachms of chloral hydrate, by the mouth or in a clyster. Failing this, 1 to 2 pints of brandy may be given. Morphine often acts as an excitant; chloral is preferable. To diminish the severe straining, if the animal is standing, continuous powerful pressure must be exercised over the loins. Where the prolapsed portion is large the rectum and bladder should first be emptied. To provoke micturition it is often sufficient in cows, &c., to lift the protruding mass and pass a finger into the urethra; should this fail the catheter must be passed.

After carefully cleansing the prolapsed part with 2 per cent. carbolic or dilute iodine solution, and removing any traces of foetal membranes, the operator must discover whether any deep injuries exist. It may be necessary to insert sutures. The size of the prolapsed mass often presents a serious obstacle to reduction. In such cases the late Professor Robertson used to effect methodical compression by passing a long, broad strip of linen around the uterus and causing assistants to pull steadily on the ends. A broad strip of Mackintosh cloth or a linen sheet may be used for the same purpose, the uterus being placed in the middle of the sheet, which is held by the ends, and twisted until compression of the womb takes place. If the patient be tympanitic puncture of the rumen or cæcum may be necessary.

The first portions to be replaced are those lying nearest to the vulva, particularly the upper sections, the other prolapsed parts being meanwhile supported; an attempt is then made to thrust these into the vagina, and with the fist applied at the point farthest from the vulva to pass the entire mass as far forward as possible.

To prevent rupture and to assist replacement, the manipulations are made when the animal is not straining.

After reduction, by stretching out the fingers within the uterus, the folds may be completely got rid of—the same object is served by injecting lukewarm water. Instruments should be avoided. They may cause perforation when the animal strains.

Becker uses Günther's parturition crutch. With the half-closed hand, he thrusts the lowest portions of the uterus as far as possible into the vagina, then introduces the previously well-oiled rounded end of the crutch along the arm as far as the hand, and, whilst returning the crutch with the other hand, withdraws the arm from the vagina. An assistant holds the crutch firmly, without thrusting it further forward, while the operator, by using both hands, passes any portion of the uterus still in view into the vagina, reintroduces the right arm, removes the crutch, and endeavours to place the uterus into its proper position. The assistant then passes his left arm into the vagina or uterus alongside the operator's right, closes his hand, and whilst the operator removes his arm, the assistant keeps his in position for an hour. The cow is watched for the next ten to twelve hours to prevent straining, in which case the hand should be pressed against the vulva. If possible, the animal should, after reposition, be kept standing. Operation is facilitated by previously giving a couple of ounces of chloral dissolved in a pint of water.

In order to ensure retention, some operators recommend keeping the arm for some time in the womb, and only withdrawing it when contraction occurs or straining stops. Others, thinking this encourages straining, replace the uterus, give an anodyne, and apply a vulval clamp or rope truss, or insert hip-sutures. By introducing small pieces of ice or very cold water into the rectum, contraction of the uterus is excited, and recurrence prevented. The measures recommended in prolapse of the vagina may be tried, but complete reposition, and the return of the entire uterus and its horns to their proper position, is much more likely to be successful. Closure of the vulva is only of value in preventing injury to the prolapsed parts, and is most easily and securely effected by using West's clamp or tape sutures. Two or three sutures are sufficient. Pessaries—as an inflated pig's bladder or rubber bag, or tampons of cotton wool and gauzes—are sometimes passed into the vagina before the clamp or truss is applied. Unfortunately there is no external appliance that will prevent invagination of the uterine horn, and therefore careful reposition of the womb is of prime importance.

In cases where the violence of the expulsive efforts renders

reduction very difficult some operators have had excellent results from slinging. The hocks are fastened together and the hind-quarters raised from the ground by means of a block and tackle until the animal rests on the sternum. In this nearly vertical position the prolapse is easily reduced, and the animal is cautiously lowered until the hind-quarters rest on a bed of straw considerably higher than the surrounding parts. This manipulation can be repeated if necessary.

When reposition is impossible, or the prolapsed organ is much damaged or necrosed, amputation is the only resort. In cows it is simple, and not particularly dangerous, but in no animal should it be attempted until all other means have been tried or at least considered. St. Cyr lost six animals of a total of twenty-five; Franck describes thirty cases of amputation, of which four (two cows and two goats) had to be slaughtered. Lanzillotti-Buonsanti has collected records of 140 cases. Of 86 cows, 77 recovered and 9 died; of 8 mares, 6 recovered and 2 died; of 27 cows, 22 recovered and 5 died; of 9 bitches, all recovered; of 4 goats, all recovered; of 3 sheep, 2 recovered and 1 died; of 3 cats, all recovered. Nevertheless, these figures are not to be implicitly relied on. They truly represent the records, but successes are more often recorded than are failures. When the animal is not cast, precautions must be taken against its lying down or kicking the operator. The surface is then cleansed, and care taken to discover by palpation that no portion of bowel or bladder is included in the inverted uterus. A strong tape or cord, in the form of a surgical snare, is then passed round the neck of the uterus, avoiding the urethra, and drawn very tight. In this case, as in all where large masses of tissue have to be ligatured, it is necessary to proceed slowly. The ends of the cord are tied to pieces of stick to ensure a better purchase, and the ligature is drawn tight; the operator then waits a few seconds to allow the tissue fluids to filter away, and again tightens the cord; if the prolapsed uterus is much swollen, the procedure requires repeating several times. The elastic ligature has been recommended and successfully used on sheep and swine by several operators. After applying the ligature, the organ is cut away.

In large animals, and where swelling is great, amputation by multiple ligation has been recommended, or the mucous membrane can be divided and the ligature applied to the muscular and serous coats. These methods, however, have no particular advantage over that above described. Bang also prefers the ligature; the portion thus tied off can at once be cut away, but should movement

of the ligature be feared, or further tightening become necessary, amputation may be postponed till next day. In such cases care must be taken that the weight of the uterus does not cause it to tear away, a complication that may cause much difficulty. Hering recommends, where the animal is able to stand, to lay the prolapsed parts on its quarter. Without question, however, it is better to remove them at once, if for no other reason than the fact that this allows of reposition of the vagina. To remove inflammatory products from the ligatured stump, the vagina must be repeatedly washed out during the following days. If swelling is severe, it may be necessary to pass the catheter. Should further prolapse of the vagina result from severe straining, either the truss, or West's clamp may be applied, or a few stitches inserted across the vulva. The operation is not without danger; loops of bowel may protrude, and cows often show great nervous excitement for some time after operation.

In bitches, the uterus has repeatedly been amputated with success. In them also the displacement of the pregnant uterus, in inguinal hernia, may render the operation necessary. Antisepsis must, as far as possible, be practised.

In small animals, and especially in goats, prolapse of the uterus has been reduced by injecting water. The animal's hind-legs are held up, the smaller horn of the uterus reduced and filled with lukewarm water. The weight of the water carries back the horn of the uterus to its normal position. After the second horn has been replaced by the same method (though great difficulty is often met with here), the uterus is also filled with water, and after replacement, the fluid is allowed to escape by placing the animal in the horizontal position. The lips of the vulva are closed with a loose button suture left in position for three days.

IV.—TUMOURS OF THE VAGINA AND UTERUS.

As a rule, tumours in these organs are commoner in the human species than in animals. Fibromata in particular seldom attain the extensive development here which they do in the human subject, though fibromata, carcinomata, sarcomata, and especially retention cysts have repeatedly been seen in the vagina of cows. Such tumours also occur in bitches (fibromyomata), but are rare in other animals.

In bitches, partial prolapse of the upper wall of the vagina sometimes occurs, attended with severe swelling in the prolapsed part, and is generally regarded, and even treated, as a fibrous new growth. A pale red ovoid swelling suddenly appears in the vulva, generally attains the

size of a hen's egg, and cannot be returned, or if returned, soon appears again. The prolapse is commonest during the time of heat, and after successful coitus.

Heckmann found in the vagina of a bitch a pedunculated polypus, which arose from the right wall, and was removed by ligation. Zipperlen describes a polypus on the cervix of a cow; Leblanc a similar growth in a bitch.

In cows, the most common growths are cysts, which occur in the vestibule of the vagina, particularly on the left side. They result from blockage of Bartholin's glands, while those occurring close behind the opening of the urethra are due to occlusion of Wolff's duct. Eggeling detected, in a cow's vagina, a sarcoma telangiectodes, which led to death by bleeding during parturition. Ulcerating carcinomata have repeatedly been found both in cows and bitches; Bang saw carcinoma of the vestibulum vaginae in a cow.

Sand saw severe bleeding from vaginal varicose veins in a mare. The bleeding could not be stopped, and in consequence of progressive anæmia the animal had finally to be slaughtered.

Gilruth described an epithelioma of the vulva and vagina in an aged cow. The external growth was about 7 inches long and 6 inches wide, implicated both labiæ and the lower part of the anus, and extended about 8 inches into the vagina. The animal was killed. The pelvic and posterior mesenteric glands contained small, greyish soft nodules (Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery").

Apart from tuberculosis, the uterus is seldom the seat of tumours, and still less frequently does it call for surgical treatment on their account. The changes, often described as scirrhus, probably result from endometritis chronica, though polypoid new growths occur, and are sometimes of considerable extent; Bedenberg found in the uterus of a cow a tumour which weighed between 28 lbs. and 30lbs. Carcinomata and sarcomata have repeatedly been seen in bitches; Esser found a fibroid of the uterus in a cow.

In a cow which had suffered from periodical bleeding from the vulva, Eckhard found a fibroma of the uterus, weighing 52 lbs. Gratia, in a cow, discovered a large fibromyoma that had existed for several years, and had repeatedly caused profuse bleeding. As the new growth rendered parturition difficult, it was removed by ligature, but the animal died from acute peritonitis. Von Bockum-Dolffs found tuberculosis of the uterus in a cow which had been regarded as pregnant. The animal was found on slaughter to have general tuberculosis, the uterus being greatly distended with caseous material.

Symptoms. Tumours of the vagina sometimes appear beyond the vulva during urination, and becoming strangulated, are at once recognised; their position and extent are detected by palpation. The same is true of new growths within the vagina. They seldom give trouble unless when of large size, and then because they injure the animal's appearance, or interfere with parturition or urination.

They frequently produce bleeding or chronic discharge from the vagina, which, in the case of ulcerating new growths, assumes a purulent character. The cysts which occur in cows sometimes protrude from the vulva, appearing as bladders about the size of a hen's egg, and containing clear or turbid fluid.

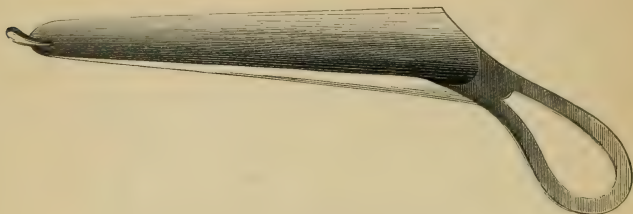


FIG. 444.—Simple vaginal speculum.

Tumours of the uterus are seldom recognised until they produce difficulty in parturition; they often render animals barren. In the larger animals they can be discovered by rectal examination. Tuberculosis sometimes produces great increase in size, either in one horn or in large tracts of the uterus. The Fallopian tubes then appear like hard cords as thick as a man's finger, arranged in curves,

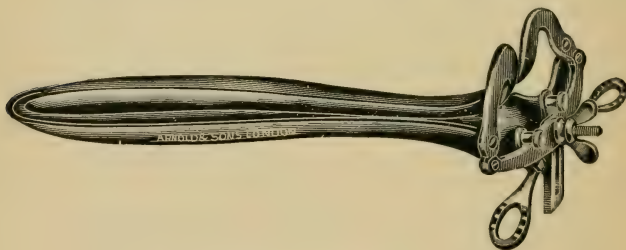


FIG. 445.—Expanding vaginal speculum (closed).

and there is usually a muco-purulent vaginal discharge mixed with masses of firmer consistence and containing tubercle bacilli.

Prognosis depends chiefly on whether the growth can be entirely removed. This is, of course, easier in vaginal than in uterine tumours. In pregnant animals uterine tumours become much more dangerous; and those which produce severe straining, and thus favour prolapse, are particularly troublesome. Vascular tumours may cause death by bleeding.

Treatment consists in operative removal. Pedunculated tumours can be ligatured, and multiple ligation is also the best method of dealing with partial prolapse of the vagina in bitches. Sessile tumours may be removed by enucleation. Tumours lying further forward may sometimes be removed with the *écraseur*, cysts are burst by the pressure of the hand; if necessary, the operation can be repeated, and the base of the tumour cauterised.

Cadiot and Dollar ("Clinical Veterinary Medicine and Surgery") describe a case of myxoma of the uterus in a bitch. The swelling projected slightly beyond the vulva, was ovoid, smooth, of fairly firm consistence, and reddish in colour. It measured 5 inches in length and 6 inches in

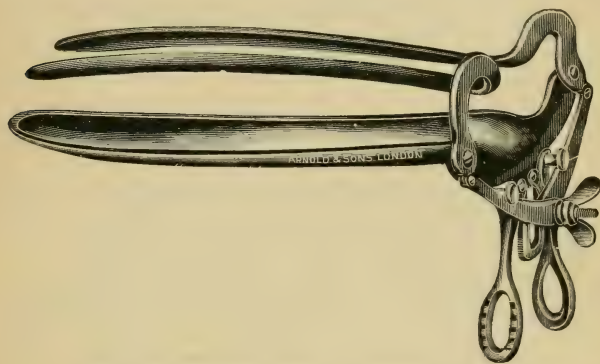


FIG. 446.—Expanding vaginal speculum (open).

circumference. Removal by ligature of the pedicle and section on the peripheral side was followed by recovery.

Müller treated a bitch with fibromyoma, complicated with prolapse of the vagina, by injecting ergotin (extr. sec. corn. grs. vii., spirit. dil. et glycerin. aa. m. lxxv.): of this fluid m. xv. were hypodermically injected at the most convenient spot. In four weeks the swelling had greatly diminished, and complete recovery finally occurred, but whether as a result of the injections is not altogether certain.

Malignant tumours of the uterus are not common in the domesticated animals, and are rarely diagnosed during life. Where, for reasons of sentiment, the owner attaches unusual importance to the animal's preservation, ablation of the uterus may be performed, but the operation is only practicable in small animals.

Atresia, complete or incomplete, of the neck of the uterus frequently renders animals sterile and calls for operation. In incomplete atresia the entrance to the uterus can usually be dilated

by introducing the finger, or a sponge tent, or by injections of warm water, but in some subjects dilatation can only be effected by the cautious use of a sound.

V.—DISEASES OF THE MAMMARY GLAND.

THE mammary gland comprises parenchyma and stroma. The formation of the former is partly vesicular, partly tubular. In the connective tissue of the stroma lie variously-shaped spaces, the gland vesicles or acini, which open into the lactiferous canals or gland ducts. Both are lined with cylindrical epithelium, and together form the milk-secreting tissue. The milk flows thence into the milk ducts or collecting canals, to pass either directly outwards through the teat (man and carnivora), or in herbivora, into a cavity at the base of the teat, termed galactophorous sinus or milk cistern. In ruminants the udder has only one galactophorous sinus and teat for each division or "quarter"; but in the mare's udder each teat is supplied by two or more sinuses. From the galactophorous sinus a narrow canal (teat duct), lined with mucous membrane, leads to the exterior, and in the mare two of these exist in each teat, in ruminants only one. In swine, each teat has two, sometimes three ducts, in communication with as many small milk cisterns. In herbivora, then, each teat corresponds to a particular division of the udder, in the cow, to a quarter, in the ewe and the goat, to one half of the udder. In carnivora the divisions of the udder (ten in the bitch), are, externally, not so sharply bounded, and each is connected with the six or more openings on its corresponding teat. The cat has eight glands and two orifices on each teat.

Each gland, independently of the modified skin that forms the external covering, is surrounded by a capsule of fibro-elastic tissue, which supports and assists in holding the gland in position. This capsule is reinforced in places by suspensory bands which are connected on each side with the tunica abdominalis. Externally it closely adheres to the skin; in the mesial plane it is confounded with the capsule of the opposite gland; and internally it furnishes numerous intercrossed septa, which pass into the substance of the gland, dividing it into lobules and lobes more or less distinct.

A double system of lymph vessels exists in the udder; the one lying near the surface arises from the capsule, and is connected with the lymphatics of the skin; the other invests the acini, which are surrounded by fine lymph vessels. Fürstenberg distinguished between the surface lymph vessels arising close under the skin, which pass into the depths along with the chief veins, and those which arise from the plexus in the interior of the gland, and accompany the deeper-lying venous branches. Fürstenberg held that during lactation the lymph vessels appear to be distended with lymph. He also succeeded in filling them with air from the milk ducts, and discovered a valvular arrangement in them.

The retro-mammary lymphatic glands are two in number, and are situated above the posterior quarters, outside the capsule of the glands and close to the perineum. The superficial collecting vessels are dispersed under the skin and anastomose with one another on the surface of the gland, the anastomosis being most intimate between those of the same quarter, finally emptying separately by two large channels into the retro-

mammary lymphatic gland of the same side. The lateral efferent lymphatics are divided into two groups, one of which ascends in the perineal region, towards the lymphatic glands round the anus; the other passes with the blood vessels through the inguinal canal towards the sublumbar region.

The mammary arteries are derived from the external pudic; the veins form two series, one accompanying the mammary arteries, the other, more superficial, furnishes the roots of the subcutaneous abdominal vein. Two nerve branches from the lumbar portion of the spinal cord are distributed to the mammary gland. Their mode of termination is unknown.

The skin covering the udder shows no special peculiarity; it possesses few or no hairs, but, on the other hand, has in places well-developed sebaceous glands and large papillary bodies.

In cattle, the skin of the teats is free of glands, and has no hair. In the teat of the mare, especially near the opening of the milk canal, many glands are found. In sheep and goats, the skin of the teat is covered with a soft hair, and is rich in glands, particularly at its lower end. In swine, the teat is devoid of hair and glands; but in dogs, single hairs and sebaceous glands exist.

(1.) WOUNDS AND BRUISES OF THE UDDER AND TEATS. LACTEAL CALCULI.

Wounds, &c., of the udder and teats are most frequent in cows, and are caused by treads; animals with large pendulous udders may even tread on their own teats when rising. Similar injuries are also caused by bites (from dogs) or by sharp objects like thorns, when the animal breaks through or leaps over hedges. Sometimes the skin is divided, sometimes only bruised.

Surface wounds—that is, such as neither penetrate the gland substance nor the milk ducts—are of no particular importance, and may be treated on general principles. Considerable bleeding sometimes occurs at the base of the teat; and should the wound open into the gland, there is some danger of the formation of milk fistulæ. Though healing then appears to proceed satisfactorily, cicatrisation fails to occur, on account of the milk continuously flowing through the wound, which nearly closes, but leaves a little funnel-shaped opening, termed a milk fistula. This is, however, only to be feared during lactation. Injuries of the teat may produce cicatricial contraction, and consequent difficulty in milking.

Bruises of the udder cause bleeding, either into the gland ducts, the milk then being mixed with blood, or into the skin and subcutaneous tissue. The blood may be absorbed, as in other soft parts, or infection may occur with formation of an abscess.

Treatment. In all deep wounds of the udder the first object should be to obtain healing by first intention. Provided the injury be recent, and seem to warrant such an expectation, the edges of

the wound are carefully disinfected and sutured. It must not be forgotten, however, that during lactation milk fistulæ often resist the most careful treatment, though they readily heal when the animal becomes "dry." The gaping of wounds of the teats and escape of milk can sometimes be prevented by applying a well-fitting rubber ring, which, however, must not be too tight; adhesive plaster, collodion or wound gelatine may be employed for the same purpose on the hairless or previously-shaven udder. Hertwig recommends a liniment of alum and albumen, which should be applied to the thickness of an eighth of an inch or more. During lactation, however, every means may fail, because the udder is continually filling and emptying, and the skin changing in tensity. The use of a milk catheter, by allowing the milk to discharge from the affected section,

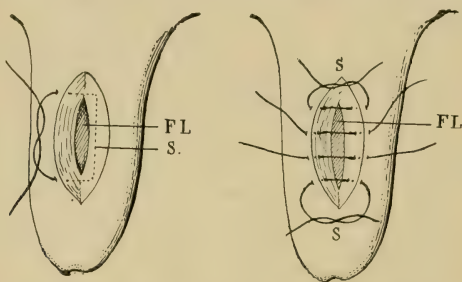


FIG. 447.—Milk fistulæ. 1, deep suture—schema showing the course of the suture; FL, base of the fistula; S, suture; 2, superficial interrupted suture.

often gets over the difficulty and ensures healing by primary intention. If immediate healing be no longer possible, treatment must follow general principles. By observing careful relative antisepsis, extension of infection, pus formation and cellulitis can be prevented. Closure of fistulæ may be sought by using caustics or by inserting deep as well as superficial sutures; during treatment a milk catheter should be used. All other methods failing, the end of the lactation period must be awaited, when the fistula can generally be closed by cauterising the edges with nitrate of silver or by suturing.

Bruises, accompanied by the passage of blood-stained milk, require the udder and the teats to be kept clean, so as to prevent infection. The removal of the blood and milk is best effected by catheter. Moist warmth in the form of poultices assists resorption. So-called resorbent applications like mercurial ointment rarely effect

any good, though they serve to pacify the owner. If licked by the cow or calf they may prove positively dangerous, and under any circumstances are apt to enter the milk.

Calculi sometimes form in the mammary gland or galactophorous sinus. They consist chiefly of organic substances, but usually contain a considerable quantity of phosphate of lime, form rounded masses varying in size and number, though they are not often numerous, and can be detected by palpation of the udder or teat. Those which enter the teat can usually be removed by manipulation from above downwards with the finger and thumb. Failing success by this method the teat must be laid open at the base, the calculus removed, and the wound closed by sutures. The parts (which should have been carefully disinfected before operation) can then be thickly painted with iodoform collodion, or sublimate gelatine. Calculi which do not enter the teat seldom prove troublesome.

(2.) MAMMITIS.

Authors have adopted the most varying views as to the origin and classification of the various forms of inflammation of the udder, some based on anatomical, others on clinical and pathological grounds. All of these have some justification, but none equally satisfies the practitioner and the scientist. In practice it is difficult and often impossible to distinguish between an interstitial and a parenchymatous mammitis; generally the whole gland is invaded at the end of a few days, whatever the point of origin, and the inflammation is therefore of a mixed character. During lactation acute inflammation of the udder is most common, especially in animals that are kept for the purpose of producing milk (cow, goat, milch ewe), but is rare in those in which the mammary function is limited to the nourishment of the young. Guillebeau says that cows most frequently suffer from mammitis between the 5th and 6th years, and that the majority of attacks (nearly two-thirds) occur in the first four months after parturition; the greatest number of these soon after the act.

The physiological activity of the milk glands in many respects favours the development of inflammation. The early processes of lactation, particularly the congestive stage, so closely resemble acute inflammation, even in their outward manifestations, that it is difficult to draw a sharp line between the two, and the inflammatory non-infectious œdema noticed by Kitt is probably of this nature. Both the vascularity of the gland and the processes necessary for the development of secretory activity clearly favour the appearance

of disturbances which readily assume an acute inflammatory character. It is, therefore, very natural that most diseases of this kind occur after parturition.

The anatomical formation also favours acute inflammation. The milk forms an excellent cultivating medium for bacteria, to which the teat ducts offer an easy point of entrance. Finally, the position of the udder is exceedingly favourable to the entrance of infective material; and as injuries to the skin of the udder, and especially to the teats, are frequent in animals, they easily form the point of origin of infective inflammation.

While formerly the causes of mammitis were divided into mechanical, chemical, thermal and specific, to-day the cause most widely accepted is infection with pathogenic organisms. No doubt a limited mammitis often results in cattle from horn thrusts, fork stabs, kicks, blows from the calf and similar injuries. The effects of chemical or thermal irritants are less obvious, though the milk may undergo changes within the udder. Chills, by disturbing vasomotor control, may weaken the defences of the gland tissues and promote bacterial invasion. After Franck had directed attention to infection in mastitis, others described different bacteria as the cause of inflammatory processes in the udder; but later investigation has shown that while numerous and varied bacteria may be found in the milk or interstitial exudates in cases of mastitis, only a few of these have been proved to be specific.

Infection may occur by three paths.

(1) The skin, which, as already remarked, often suffers slight injuries, sufficient, however, to form the starting-point of infection. We see, then, why cows are more frequently affected with disease of this character than mares, the reason being that their teats are more often injured and simultaneously infected during milking. Disease once produced spreads, especially in the course of the superficial lymph vessels of the udder, and therefore first affects the skin and subcutaneous tissue. This method of spread (lymphogenous mastitis, Kitt) is, however, less frequent than the next in order, as Johne has shown.

(2) Infection through the teat duct. In many cases pathogenic bacteria pass through the duct into the galactophorous sinus, and finally into the smallest divisions of the affected portion of the gland, producing, according to their degree of virulence, a more or less violent inflammation of the parenchyma of the udder (galactophorous mastitis, Kitt). At the first glance it appears astonishing that inflammatory processes are not more frequently produced in this

way. The apparent rarity is explained, however, by the fact that an effectual closure mechanism exists in the teat duct, and that the milk seldom remains pent up in the udder for any long time. Numerous experiments, in which pure cultures of particular bacteria have been injected into the galactophorous sinuses, show, however, that inflammation may start here. Kitt even produced mastitis by painting the teat with a pure culture.

It has been much disputed whether inflammation of the udder can be caused by not milking the animal (overstocking). Whilst this was formerly regarded as a frequent cause of mastitis, experiment has shown that retention of the milk alone never produces disease of this description. The retention of milk as such, certainly does not produce mastitis, but it favours its production, because of the readiness with which decomposition and the growth of bacteria occur in the retained milk and cause inflammation.

This explains why mastitis is most common during hot weather ; Strebel says most cases occur between March and September. Other factors may also be at work, such as the animal's condition, the attention it receives, and the time during which the calf is with it ; but this much is unquestionable, that warm weather favours decomposition of the milk, and the multiplication of bacteria.

(3) Finally, infection through the blood stream appears possible (hæmatogenous mastitis), though it is probably very rare.

It also seems possible that when the disease is widely spread, or conditions are favourable for the transmission of the specific microbe, mastitis may take an epizootic form ; the infecting material being easily carried from animal to animal during milking. It is not astonishing, considering the varying virulence of pathogenic microbes, that many different forms of udder infection occur, so that sometimes only slight irritation, sometimes severe inflammation, or sometimes gangrene results.

In view of the intimate relationship that exists between the parenchyma and stroma of the gland, it is scarcely surprising that acute inflammatory processes often extend from one to the other, that in inflammation of the parenchyma the stroma, and in disease of the stroma the parenchyma, often suffers. The former occurs the more readily, because the blood-vessels of the udder ramify without exception in the stroma.

(3.) ACUTE MAMMITIS.

(A) INTERSTITIAL MAMMITIS. LYMPHOGENOUS MASTITIS.

This disease affects the skin, subcutis, and interstitial connective tissue. It generally starts from the teats, which in the cow very frequently suffer from surface injuries, the rough hands of the milker abrading the skin and possibly conveying infective material; the straw may also cause injury and infection. The micro-organisms first enter the skin and subcutis and set up inflammation, which generally extends to the capsule and the stroma of the gland.

The process, therefore, seldom remains confined to one quarter, but extends to several, or may even attack the entire udder. The course of the lymph vessels of the separate teats, however, sometimes causes the disease to remain confined to single sections of the gland. The skin and subcutaneous tissue are at first cedematous, and later become infiltrated with plastic material; slight exudation of blood is not uncommon. We clearly have to deal here with an acute inflammation, caused by infection through slight fissures and cracks in the skin, particularly of the teats. The disease is probably caused by pyogenic cocci or other microbes. Kitt produced the disease in cows by infecting them with the bacillus of malignant edema.

Symptoms and course. The condition is announced by a rise in temperature of 2° to 5° Fahr., loss of appetite, cessation of rumination, acceleration of breathing and circulation, constipation and tympanites; and locally by swelling and redness, which is generally diffuse, and seldom limited to particular portions of the gland. It appears suddenly; the skin is injected, at first it appears bright red, afterwards bluish. The swelling is then soft and doughy, but later becomes hard and firm, and requires some force to indent it. The skin is often exceedingly hot, but pain, as in subcutaneous inflammation, is seldom severe, nor does the milk show much change in quality, though the total quantity is greatly diminished, and in the affected gland secretion may be arrested.

In five to eight days the symptoms may gradually subside, the redness and swelling disappear, and the secretion of milk return. In other cases abscesses form. In or just beneath the skin, less frequently in the superficial portions of the gland, several fluctuating points develop, which after a short time break and discharge pus. Such abscesses are distinguished from those occurring during parenchymatous mastitis by their superficial position and small

size. This disease may also lead to another complication, local or diffuse gangrene. It is due to thrombosis of the vessels of one or several gland lobules, and is indicated by aggravation of the general symptoms, great weakness of the patient and heart failure. Locally, the skin of the udder assumes a blackish-violet tint, and becomes cold and clammy. Death follows from exhaustion and intoxication.

(B) PARENCHYMATOUS MAMMITIS. CATARRHAL MASTITIS.

In this form infection occurs through the teat. Sometimes the galactophorous sinuses alone suffer, but generally the large milk ducts are also attacked. The process may also extend to the smaller milk ducts, and even into the acini of the gland. It rapidly passes through the glandular wall into the interstitial tissue, thus forming a mixed mammitis. When the process is confined to the galactophorous sinus and collecting tubes, the quantity of milk secreted is little diminished, though as inflammatory exudate from the diseased mucous membrane is mixed with it, its quality may be considerably altered. The more extensively the small ducts and acini are involved, the greater the diminution and change in the milk. In consequence, this disease by no means offers a constant train of symptoms.

Symptoms. These vary in intensity according to the case, and usually occur in the following order:—Swelling of one or several quarters, presence of curdled milk in the milk cistern, then of clots mixed with reddish serosity; rapid diminution or cessation of the secretion of milk, and frequently suppuration in the depths of the gland. The general condition of the patient may be little altered, or there may be fever, loss of appetite, cessation of rumination, constipation, groaning, and more or less difficulty in walking. In severe attacks, infection spreads rapidly from the glandular to the interstitial tissues, and there is considerable subcutaneous abdominal and perineal œdema. The udder is tense, shining, very sensitive, and of a reddish-violet colour.

Parenchymatous mammitis may terminate by apparent recovery in three or four days; the symptoms gradually subside, milk returns, and the udder regains partially or wholly its former condition. Complete restoration of function is, however, quite exceptional, and in cases involving the smaller milk ducts and acini the inflammatory process often assumes a chronic course, producing thickening of the mucous lining with occlusion or stenosis of the ducts, and eventually induration and atrophy of the gland.

Suppuration is common. A single deep-seated abscess or several smaller abscesses may form wherever obstruction has occurred. Evacuation of the pus may be effected by traction of the teat, but the suppurative process destroys the function of a considerable portion of the secreting tissue. Gangrene, except in neglected cases, is less common. Its occurrence is preceded by marked relapse in the general symptoms. The affected quarter assumes a purplish colour, its integument appears blotchy and oedematous, and traction of the teat produces a red, purulent, offensive fluid containing particles of necrotic tissue. Sloughing of a portion of the quarter or the whole of it, and even death may take place within thirty-six hours of the first symptoms of gangrene, which tends to implicate other parts of the udder.

Prognosis. The prognosis of acute mammitis, interstitial or parenchymatous, should always be guarded. There may be no danger of a fatal result, but the value of the animal as a milk producer is always greatly depreciated. In some cases the function of the udder may be arrested for the whole of one lactation period; and there is a constant tendency, even in mild attacks, to chronic mammitis of one or more sections of the gland. Suppuration is a very serious complication, as it not only prolongs the inflammatory process but also leads to the destruction of large tracts of the gland tissues. In forming a prognosis attention should be paid to the course of the disease; the longer it has existed the less the chance of complete recovery.

Treatment. Though numerous measures have been proposed, there is no recognised method of treatment that will certainly arrest the disease and restore the inflamed gland to its normal condition. At first, treatment should be of a prophylactic character. The severity of acute mammitis can be greatly lessened by placing the animals under proper hygienic conditions, giving special attention to disinfection of the cowshed, the cleanliness of the milkers' hands, and any instruments introduced through the teats; by avoiding overstocking, and by careful treatment of digestive disturbances, and of wounds or excoriations of the teats and udder.

General treatment of the patient is always required. In robust animals that are highly fevered, moderate bleeding from the jugular lowers the temperature and tends to mitigate respiratory and circulatory complications. Bleeding from the mammary vein is less effective, and owing to the risk of wound infection is not advisable. In all serious cases digestion is inactive or intermittent and as constipation favours auto-intoxication, the alimentary canal

should be cleared out as soon as possible. For this purpose saline purgatives with diuretics are usually prescribed, but preference should be given to those agents (pilocarpine, eserine, etc.), which, administered subcutaneously, act quickly on the bowels. Tympanites may be prevented by care in dieting, offering laxative and easily digested food; and in cases of relapse stimulants and nerve tonics must be prescribed. Whether or not the inflammatory process in the udder can be abated by medicines administered by the mouth is uncertain, though some practitioners assert that improvement generally follows a course of potassium iodide, or the orange sulphide of antimony, both of which, in healthy animals, are partly excreted in the milk.

Local treatment includes massage, various applications to the surface of the udder, and intra-mammary injections. Ointments of camphor, opium, hemlock, or belladonna are considered to be of real service in relieving pain in the early stage of the disease, and repeated disinfection of the udder is said to check extension of the infective process. Cold affusions, hot compresses, and poultices of spent hops have been strongly recommended. Bang suggests linseed or oatmeal poultices, and the application of linen or woollen cloths wrung out of hot water and kept warm by covering with Mackintosh. Fomentation with diluted alkali or soap and water have often been advised. Once tension and pain diminish, the parts may be smeared with flour paste and covered with wadding. Vogel uses a mixture of two tablepoonsful of water, four of starch, twenty of glycerine, and one of turpentine. When warm the mass forms a paste, which is applied thickly and left on for fourteen days. From time to time it may be removed to allow of massage, which is of considerable assistance in this disease. Infriktion with unguentum hydrargyri is useful. Johne employed a mixture of equal parts of blue ointment, potash, soap and lard. Franck used an ointment of ol. hyoscyam. 8, liquor ammon. caust. 2, camphor 1. Slinging the udder, and warm fomentations frequently repeated, relieve tension, tenderness and pain; and massage, or infriktion with camphorated oil, mild fats, or weak ammonia liniment promotes the circulation in the inflamed gland. For a few days, in most cases, the teats should be drawn every hour to remove exudates, milk clots, etc., from the galactophorous sinuses; and the interior of the gland, especially in parenchymatous mammitis, should be irrigated, after drawing the teat, with antiseptic fluid introduced through a milk catheter. For this purpose solution of boric acid (5 per cent.), hydrogen peroxide (3 per cent.), carbolic acid (1 per cent.), or physio-

logical saline solution may be used. Two injections at an interval of three or four days may be sufficient. After injection, the teat is compressed and the solution is made to penetrate as far as possible by gentle massage of the gland; half an hour later the fluid is withdrawn.

In practice, intra-mammary injections are not easily carried out. There may be little accommodation within the udder and in consequence, the injection is immediately returned; but by carefully emptying the galactophorous sinus before injection, six to twelve ounces of fluid can be forced into each quarter.

When suppuration occurs, attempts should be made to remove the pus through the teat, but as soon as an abscess appears under the skin it should be opened and the cavity cleansed and disinfected. Vesicants hasten the development of the abscess and facilitate puncture.

Gangrene, in some cases, can be prevented by timely scarification of the threatened gland; but when it has become established medical treatment is seldom of much value, and operation offers the only hope of saving life. Partial amputation becomes necessary when necrosis occurs during the progress of an attack of mastitis. Practitioners should, however, be cautious, and only operate where necrosis is circumscribed. Unless signs of demarcation are visible partial amputation is very liable to prove disastrous. The operation succeeds best in cows. In them one-half of the udder can be removed without septic processes extending to the other half, the suspensory apparatus forming a very effective septum between the two portions.

Total amputation is justifiable in acute forms of mastitis if thereby the process can be terminated. This is the case in the severe gangrenous forms in ewes and cows, where, save for operation, death is almost certain. Strict antisepsis is necessary. The patient should be secured in the dorsal position, the hocks flexed and held well apart. Two incisions, one on each side, are made from before backwards, so as to include the four teats in the flap of skin, which is left attached to the udder between the incisions. All vessels, including the veins, must be ligatured to prevent secondary bleeding. After dividing the skin, dissection is carried on with the fingers, a director or other blunt instrument, until the udder only remains adherent to the suspensory ligament, which is then divided. The cavity is freely powdered with iodoform, filled with sterilised tampons of tow or cotton wool, and the edges brought together with sutures, which may be left in position for forty-eight hours. After

this time sutures and tampons can be removed and the parts treated as an open wound. Healing sometimes occurs under a dry scab if iodoform-tannin be freely used.

(4.) CHRONIC MAMMITIS

May result from an acute attack, or it may arise from infection at any time during or after the period of lactation. Frequently it is discovered immediately after calving, when the cow should be in full milk. The milker finds one quarter of the udder more or less indurated and "weak," that is, giving little milk, or only a fluid of doubtful character. When chronic mammitis follows an acute attack the constitutional symptoms of the primary affection gradually decline and disappear, but the affected quarter does not resume its function; the secretion of milk is almost entirely suspended, and traction of the teat produces a watery fluid with some curd, which may be blood stained. Induration, partial or diffused, follows and eventually the gland becomes atrophied with complete loss of function. Abscess formation is rare; though sometimes pus is found in the fluid obtained from the affected quarter.

Treatment is almost useless in chronic mammitis. In cases associated with purulent catarrh antiseptic injections may be tried, or the teat may be excised. Removal of the teat gives free and continuous escape to the pus, and probably hastens fattening. If only one quarter is indurated and atrophied, the cow may be kept with profit, but when two or three quarters are affected the animal should be prepared for slaughter. Vesicants, ointments of iodine, mercurials, etc., applied to the defective gland seldom prove beneficial.

(5.) CONTAGIOUS MAMMITIS. STREPTOCOCCIC MASTITIS.

This disease was recognised as early as 1882 by Gerlach in Berlin. Kitt, in 1885, named it "Contagious Catarrhal Agalaxia;" and in 1888 Hess and Borgeaud described it under the title of "Gelber Galt." The cause, however, was unknown before the investigation of Nocard and Mollereau, who found, in 1884, the specific streptococcus, a discovery which was subsequently confirmed by others in Germany, Switzerland, Denmark, Italy, and England.

Contagious mammitis of milch cows always assumes a chronic course. Infection takes place through the teat canal, and the contagium is transmitted from the diseased quarter to healthy sections of the udder, or from one cow to another by the hands of

the milker. Frequently the disease is spread by the disposal of dairy stock, or by the introduction of an infected cow into a healthy herd; and the contagium may be conveyed from an infected cowshed to healthy cattle by milkers who may be employed on more than one farm. It is a very contagious disease; sporadic, enzootic and epizootic forms have been described. The infective agent produces catarrhal inflammation of the mucosa of the milk cistern and galactophorous canals, and by gradual extension of the process, induration of the interstitial connective tissue with consequent atrophy of the corresponding parenchyma of the gland.

Symptoms. The general health of the cow may not be sensibly disturbed, though some cases are ushered in with cough, slight nasal catarrh, and offensive diarrhæa. Infection of the udder is indicated by marked diminution in the quantity of milk obtained from one quarter. The milk appears normal but does not keep well; it quickly coagulates on standing, and causes clotting when mixed with good milk. A nodular induration develops in the quarter towards the base of the teat. This nodule is small, of rounded or ovoid shape, and not well defined at its periphery. It gradually enlarges without any symptom of acute inflammation except congestion of the integument of the quarter, which may be œdematous and painful to manipulation. The milk becomes thin, serous, and of a bluish colour, and microscopical examination reveals numerous streptococci. Induration extends very slowly; at the end of several months it may only have invaded a third of the infected gland. Concurrently with the increase of induration the milk presents further changes. It becomes yellowish or reddish-brown in colour, grumous, foetid, and distinctly acid, and contains numerous coagula.

At first, the disease may be confined to one quarter, but generally, unless precautions are taken, it extends from one quarter to another, until the whole udder is involved.

The prognosis is favourable so far as life is concerned, but decidedly unfavourable as regards restoration of the function of the gland. Moreover, in those cases where the disease seems to have been arrested it oftens reappears during the next lactation period. When only one quarter is attacked, the cow may continue useful as a producer of milk, even though the quantity be reduced by one fourth; but when two quarters are indurated the cow should be prepared for the butcher, as the yield of milk from the remaining healthy quarters hardly repays the cost of feeding.

Treatment should be preventive as well as curative. Prompt isolation of the first case and thorough disinfection of the cowshed

are imperative. The hands of the milkers and the udders and teats of the healthy cows should be washed and disinfected before and after milking, and attendants on infected cows should not be allowed to come in contact with healthy cattle. As a rule the milk from the diseased udders should be destroyed. Further treatment consists in attempting to destroy or render innocuous the infective material in the udder and to combat inflammatory changes. The former may be effected by injecting disinfectants, though practitioners hold very different views as to their action; and while some advise injections, others consider they are of no particular value. Though they penetrate the galactophorous sinuses and larger milk canals, they fail to reach the smaller milk ducts and acini.

Nocard advised the injection of a 4 per cent. warm solution of boric acid, repeated two or three times at intervals of five or six days. Others recommend 3 per cent. solution of sodium fluoride, Sanitas, or hydrogen peroxide. Eggeling advises injecting with a rubber canula a one-fifth per cent. to one-quarter per cent. sublimate solution into the galactophorous sinus, distributing it as much as possible by cautious manipulation, and removing it in ten to fifteen minutes by milking. Franck used 2 per cent. alum or 2.5 per cent. carbolic solution. Kiekhäfer had good results from injecting 4 per cent. solution of boric acid and washing the udder externally with 5 per 1,000 sublimate solution. When the healthy quarters still give milk, carbolic acid must be avoided, because it makes the milk unpotable. Weak solutions of iodine in potassium iodide are worth trying. The solution should only be of a very light sherry colour. It can then be freely injected. The udder should be stripped beforehand, the fluid injected, the parts freely massaged, and the fluid withdrawn.

Johne saw in cows **furunculosis** of the udder, which spread rapidly in the affected herds, and lasted for several months. Hard, red, painful swellings, as large as a hazel or walnut, occurred in the skin of the udder, generally at the base of the back teats. The neighbouring tissues were also inflamed, often appeared livid, and the diseased centre soon increased to the diameter of a child's fist. After three to four days it pointed and broke, when a necrotic core was discharged along with the pus, in which, on microscopical examination, a dead hair-follicle could be detected. Granulation and healing soon occurred.

As a precautionary measure, Johne made the attendant wash both the udder and his hands twice daily with carbolic solution. Inoculation experiments were without result.

(6.) GANGRENOUS MAMMITIS OF MILCH EWES.

Gangrenous mastitis is commonest in sheep, though it also occurs in goats, but in the latter it does not take the enzootic form generally seen in sheep. It was described in 1823 by D'Arboval, in 1856 by Lafosse, and in 1875 by Rivolta, who is stated to have discovered the causal micrococcus. The nature of the specific poison remained uncertain until 1886-87, when Nocard isolated from the udder of a sheep suffering from gangrenous mastitis a micrococcus, pure cultures of which, injected into the mammary ducts of healthy sheep, always reproduced the disease, but in other animals only caused slight temporary swelling. Within the udder the specific micrococcus produces toxins which cause necrosis of the tissues of the gland accompanied by systemic toxæmia.

Symptoms and Course. The disease starts as a peracute parenchymatous mammitis. Severe general symptoms, high fever, loss of appetite, great weakness, pain, and a straddling gait first direct attention to the udder. Local symptoms soon develop. The skin of the affected gland exhibits redness, with bluish-violet or black discrete spots, which on palpation are found to be soft, insensitive, and very cold. These spots quickly coalesce forming necrotic patches. They are surrounded by a crepitating inflammatory œdema which extends along the abdomen, and even to the chest and thighs. Milk secretion ceases, the lambs are hungry, and many of them suffer from sores on the lips. Later, the affected ewes are constantly down, groaning and grinding the teeth in acute pain, and after a short interval, the temperature falls to below 98° or even 96° Fahr., the animals show great prostration, with rapid, shallow breathing and small or imperceptible pulse. Symptoms of toxæmia then appear, and not infrequently death follows within twenty-four hours. In exceptional cases the local process is limited. A dissecting inflammation sets in which separates the necrotic tissues and may result in recovery. This is, however, a very rare exception; the greater number of animals perish with symptoms of toxæmia. The disease sometimes is complicated by septic metritis, which may either have been produced simultaneously, or may even have occurred as the primary condition, but for the time has escaped notice.

The prognosis is unfavourable, for in many cases not even the sacrifice of the udder can save the animal's life. Though sometimes the animals survive, they never regain their former condition, but remain weak and unthrifty.

Treatment. Segregation of the diseased sheep and disinfection

of the folds, pens, or ground are absolutely necessary to limit the spreading of gangrenous mastitis. Antiseptic treatment appears to be incapable of arresting the disease. Surgical treatment alone is of any value, and consists in ablation of the affected gland, followed by careful disinfection. In mild cases early incision into the necrosing parts with antiseptic dressing of the wounds may effect improvement; but when the disease has made much progress, this treatment seldom suffices, and the animal can only be saved by amputation of the necrotic portions or the whole udder.

Esser amputated the diseased portion or the entire organ in several sheep at the beginning of an outbreak of the disease. After checking hæmorrhage, the surface of the wound was powdered with iodoform and smeared with tar. Of five sheep thus treated, only one died. Nocard recommended amputation and subsequent cauterization with sulphate of copper. Moussu has frequently practised this method of treatment without losing a case. Only the diseased gland should be removed. An elliptical incision is made, including the teat; the skin is dissected from the affected gland, the vessels are ligatured, and the fibro-elastic suspensory bands are then divided. The wound should be douched with an antiseptic fluid, then filled with aseptic cotton wool and closed by sutures, which are left in position for forty-eight hours. The sutures and tampons having been removed, the wound is disinfected, and subsequently treated by the open method. The remaining portion of the udder, if healthy, becomes hypertrophied, and often yields sufficient milk for one lamb.

(7.) TUBERCULOSIS OF THE UDDER. TUBERCULOUS MASTITIS.

Tuberculosis of the udder can scarcely be regarded as a surgical disease. It is usually of a secondary character. It appears to be common wherever bovine tuberculosis is prevalent.

The clinical appearances consist in slow enlargement of the udder, without acute inflammatory symptoms. The supramammary lymphatic glands become simultaneously enlarged, sometimes attaining the size of a man's fist. At first the milk seems unchanged, but afterwards contains tubercle bacilli (sometimes in great numbers). Still later, it diminishes in quantity and becomes thin, watery, flocculent, or curdled, and of a bluish tint.

Diagnosis is assured by the discovery of the tubercle bacilli in the milk, or by testing with tuberculin, though the clinical appearances may be sufficient to determine the character of the disease.

The prognosis is unfavourable, and **treatment** is of no value.

(8.) ACTINOMYCOSIS OF THE UDDER.

This disease occurs in cows and, much more frequently, in sows, but, owing to the peculiar mode of attack, is in the latter seldom diagnosed.

Actinomycosis appears in two forms. In one, hard swellings develop, consisting of a fibrous exterior and a central abscess-cavity studded with granulations; in the other, the little actinomycotic growths are found distributed through firm but apparently normal gland tissue. Both forms appear in the animals mentioned. The last form, however, sometimes goes on to the formation in the diseased tract of extensive abscesses, containing thin fluid pus and numerous masses of the actinomycetes.

The cause is the presence of the above-mentioned fungi. Their exact mode of entry is unknown, but that they may grow if introduced into the milk duct has been shown by Johnes, who experimentally injected cultures.

The clinical appearances consist in slow enlargement of the udder, which shows either discrete hard swellings or a diffuse, hard, slightly nodulated enlargement. Sometimes the abscesses break externally and are succeeded by fungating masses of granulation tissue, or by fistulæ, or, again, by cicatricial depressions on the surface of the gland.

Diagnosis is at first difficult. The disease is distinguished from tuberculosis by the normal condition of the supramammary lymphatic glands. Discovery of the specific fungi confirms the diagnosis.

The prognosis is unfavourable to the continuance of the milk supply, as the gland gradually undergoes atrophy. Sucking pigs sometimes die in consequence of the sow being unable to supply proper nourishment.

Treatment is often uncalled for, as the disease makes slow progress and the animals can be fattened. The use of potassium iodide in mammary actinomycosis has not yet been properly tested. As a rule, the animals should be prepared for slaughter.

(9.) BOTRYOMYCOSIS OF THE UDDER.

Botryomycosis is commonest in the mare, though it has also been seen in cows. The udder becomes converted into an indurated mass of connective tissue strewn with hard botryoid nodules containing pus, in which are found the specific fungi.

Clinically the disease appears as a chronic, gradually-extending

painless swelling of the udder, which becomes hard and knotted, and from time to time is the seat of circumscribed acute inflammatory swellings. These break and discharge pus containing botryomyces colonies. The wounds may heal, or may be succeeded by sinuses, but the udder steadily increases in size. Gradually the process may extend to the thigh and abdominal wall, producing like changes.

Diagnosis is easy, provided the pus be microscopically examined.

Prognosis depends on the degree of the disease. If the udder alone be invaded, recovery may follow amputation. Otherwise, nothing can be done, and the animal must eventually be slaughtered.

Treatment generally necessitates total amputation of the udder. Partial ablation is liable to be followed by recurrence of the disease. Treatment with potassium iodide has hitherto proved ineffectual.

Möller has repeatedly amputated the udder in the following manner :—

The mare is cast, the feet are bound to the sides, and the point of operation is thoroughly cleansed. Wherever the skin appears adherent to subjacent tissues, it must be removed by cutting round the affected spot. The non-adherent portions of skin are separated from the udder, and the latter or its diseased parts separated from their adhesions to the abdominal wall by breaking down the loose connective tissue with the fingers. Any large vessels must be ligatured. To facilitate examination of the depths of the wound, and the discovery of arterial branches lying there, all bleeding must be carefully checked by ligaturing vessels as one proceeds. Any remaining adhesions of the udder to the abdominal wall may then be included in one large ligature, and the organ cut away.

The parts are afterwards rinsed out with carbolic or sublimate solution; vessels still bleeding are tied, the cavity filled with carbolised tow, and the edges of the skin brought together with a few stitches, so as to keep the dressing in position. The stitches and tampons are removed next day, any blood washed out, and the surface of the wound, which is then left open, powdered with iodoform-tannin. The wound often dries up rapidly and a scab forms, under which healing takes place without difficulty, and without requiring further interference, in about fourteen days. Considering how favourable the position is for drainage, it will readily be understood why wound fever so rarely occurs. Deupser amputated a cow's udder in the above way on account of gangrenous mastitis.

(10.) STENOSIS AND CLOSURE OF THE TEAT DUCT.

In cows—and these alone usually demand our attention—the teat only possesses one opening, at which point the skin is reflected to cover the lower end of the duct. At the point where the skin becomes continuous with the mucous membrane, *i.e.*, about $\frac{3}{8}$ of an inch above the end of the teat, lies a sphincter or valve, which, like the greater part of the teat, consists of muscular fibres.

Stenosis of the mammary duct in cows results either from proliferation of the well-developed epithelium lining it, or from contraction of cicatricial tissue. The former of these conditions occurs while the animals are “dry,” and stenosis only appears after the next calving.

Occlusion of the duct is sometimes congenital in cows, or results from inflammation at the lower end of the teat. Diseases of the skin, cowpox, aphtha, ulcers, injuries, &c., may cause adhesion and obliteration of the opening of the duct and of a considerable proportion of its length. More frequently chronic inflammation, occurring during mastitis, causes stenosis or complete occlusion; finally, the opposing walls of the mammary duct and lower portion of the galactophorous sinuses may become adherent.

Tumours sometimes form in the upper portions of the milk duct, or folds of mucous membrane may be so disposed as to obstruct the flow of milk. The constriction or valve above referred to is not constant in character; sometimes it is represented by a fold of mucous membrane, but in other cases there is only present a circular arrangement of muscular fibres of the nature of a sphincter.

Jensen examined 2,048 teats (cows'), with the following results:

In 84 cases there were accessory portions of gland within the wall of the galactophorous sinus.

In 7 cases there were circular folds of mucous membrane. In 28 cases the walls of the teat were very thick, and the sinuses small. In 53 cases there was a nodular epithelial thickening at the margin between the duct and the sinus. In 3 cases there was a vertical dividing wall in the sinus. In 1 case there was doubling of the teat (congenital). In 1 case there were small accessory sinuses. In 6 cases there were traumatic injuries. In 9 cases there were ulcerations in the mucous membrane of the sinus. In 221 cases there were cicatrices in the mucous membrane of the sinus. In 97 cases there were papillomata in the mucous membrane of the sinus. In 9 cases there were fibrous enlargements in the mucous membrane of the sinus. In 37 cases there was thickening of the mucous membrane of the sinus. In 16 cases there was formation of septa in the sinuses.

The diagnosis of this condition offers no difficulty, though the discovery of the cause is sometimes a hard task. Congenital closure will be recognised on the first calving by the excessive distension of the udder and teat, and by the fact that no milk flows when the parts are compressed. The little piece of skin covering the opening of the teat visibly protrudes, and on attempting to pass a probe, no opening can be found in the teat ; the same is the case in adhesions, in which, however, indications of an opening exist.

In stenosis or occlusion of the duct the probe either passes with great difficulty or not at all. The milk escapes in a thin stream, while the animals evince pain by kicking or moving about. Stenosis, caused by proliferation of the epithelium or thickening of the mucous membrane, can be felt as a cord-like swelling when the teat is rolled between the finger and thumb. Induration in the upper portions of the teat may similarly be detected, whilst, in closure by folds of mucous membrane, palpation gives a negative result, and the probe meets with a somewhat yielding obstruction in the depth. This valve-like closure is occasionally indicated by those portions of the galactophorous sinus above the valve gradually becoming filled with milk and increasing in diameter, whilst those below appear small, and are generally occupied by a clear watery fluid, which, according to Larsen, always contains bacteria (cocci or bacilli). A small quantity of this fluid may from time to time be discharged. Sometimes the valve can be thrust on one side with the probe, and, for the time being, the milk allowed to flow freely away.

Treatment. The stenosed teat duct may be dilated by repeatedly introducing bougies ; thick catgut threads, 1 to 1½ inches long, provided with a knot at one end, so that they cannot slip completely into the duct, may be passed a couple of hours before or immediately after milking, and allowed to remain in position for some hours. They can be used more than once, but, to prevent infection and mastitis, the bougies should be carefully cleansed and dried on each occasion. The same is true of all other instruments, such as milk catheters, probes, &c., which must be carefully cleansed and rendered absolutely sterile. Particular care is required where the teat is inflamed, as in cowpox, aphtha, &c.

If for any reason the mammary duct cannot be dilated in this way it may be incised, or the end of the teat amputated. For the former purpose a narrow, straight tenotome, or specially-constructed "milk needle," consisting of a slender double-edged fistula knife, is employed. The operation is easiest with the udder distended. The animal is held with "bulldogs," the teat grasped with the left

hand, and attempts made to distend it with milk. The instrument is then introduced $\frac{1}{2}$ to $\frac{3}{4}$ of an inch, and the milk duct divided. As the milk afterwards flows away obliquely, it is best to divide the anterior teats in a backward and the posterior ones in a forward direction, to direct the stream in each case towards the milking-pail.

The result of division is often unsatisfactory, the wound growing up again, and stenosis becoming, if possible, still more pronounced. Inflammation of the udder may also follow, in consequence of infection with micro-organisms always to be found in the mammary duct below the sphincter. Inflammation therefore sometimes occurs, despite antiseptis. For this reason the cavity should first be disinfected by injecting a 1 in 1,000 sublimate solution, and the obstruction then divided with a sterilised "milk needle." Congenital atresia is most easily dealt with; here it is often sufficient to make a cross-shaped incision or a puncture with an inoculating needle or similar instrument.

In acquired stenosis which resists other treatment, Bang recommends amputating the lower end of the teat just over the mammary duct; the sphincter can be distinctly felt here, and its position easily determined. The animal's hind-feet are secured, and the end of the teat cut away with strong scissors, the skin being as far as possible preserved. In Denmark special forceps are used, and the teat grasped, so that the parts can be removed with one powerful cut just below the forceps. Bleeding is slight. The parts must be kept as clean as possible, to prevent inflammation in the affected division of the udder. For a short time milk flows away continuously, but this can be prevented by applying a suitable rubber ring. During the healing process, the parts gradually contract, involuntary discharge ceases, and the animal can again be milked in the usual manner.

In closure of the upper parts of the teat by indurated masses of tissue, a passage may be made by passing a thin trocar, the cannula being left in position for some time, so as to prevent adhesion, whilst the milk is prevented flowing away by stopping the cannula with a cork. The trocar is also useful in occlusion of the duct by folds of mucous membrane, though success is often only temporary. It has been suggested to remove such obstructions by dividing them with the "milk needle." In this case also relief is rarely lasting.

Madsen eradicated papillomatous growths from the galactophorous sinus by disinfecting the parts carefully, slitting the base of the teat, removing the growth and suturing the wound.

Septa in the sinus or duct have been ruptured by force applied

from without. A portion of the udder is grasped between the fingers, and the contained milk suddenly pressed against the dividing membrane until the latter gives way. Some operators use special forceps with wide rounded jaws or even two rounded staves covered with rubber tubes, between which a portion of the gland is grasped and the milk so forced against the septum.

(11.) TUMOURS OF THE UDDER.

Tumours of the udder are oftenest seen in bitches, less frequently in cows and mares. In cows and bitches they frequently take the form of papillomata or warts, and are much commoner on the teats than on the udder. Frequently they are pedunculated, and from 1 line to $\frac{1}{2}$ an inch or more in length. Those on the surface of the udder are usually larger and have broader bases; in cows, they have even been seen as large as a man's head. Their surface is rough and horny, sometimes moist and inflamed from injury during milking. Kunze found the udder of a four-year-old cow covered with numerous warts 4 inches long and $\frac{3}{4}$ inch thick, so that it resembled a large cauliflower growth; the warts were removed by ligature, and by swabbing with pure sulphuric acid.

Less frequently polypi occur on the mucous membrane of the teat ducts, and may interfere with the discharge of milk.

Cysts, varying from the size of a hazel-nut to that of a hen's egg, are sometimes discovered in the udder after slaughter. They are generally retention cysts, caused by closure of single gland ducts; their contents are sometimes clear, sometimes turbid from contained masses of fat. They are difficult to detect during life, only those which are superficial exhibiting fluctuation; those in the depths can scarcely be differentiated from indurations.

Sarcomata are seen in cows and bitches. Carcinomata, epitheliomata and enchondromata are a frequent source of trouble in bitches. Stockmann has described two cases of adenoma of the udder in bitches, in both of which there was fatal pulmonary metastasis. One case, which was not operated on, had been visibly unwell for a week before death; in the other the mammary growth was excised; death followed by gradually increasing dyspnoea on the fourteenth day. Stockmann regards adenoma as the commonest malignant neoplasm in the bitch, and states that its primary seat is usually in the mammary gland. Carcinomata are also stated to have been seen in the mare. Such malignant tumours occur in a multiple form, and carcinomata are usually accompanied by

swelling of the lymph glands. In bitches, the skin is often under great tension, the swelling sinks and forms a pendulous tumour, and its position then favours injury and ulceration.

In forming a **prognosis**, the nature, seat, and size of the new growth must be taken into account. In cows, warts on the teats give pain during milking, thus rendering the animals restless, and do not disappear spontaneously as in other positions, like the mouth.

Operative removal is not difficult, but the pain during milking is not diminished but rather increased on account of the wound. It is therefore best to wait until lactation ceases. If this cannot be done, pedunculated warts must be removed close to the skin, using scissors, and the surface cauterised with nitrate of silver, which will also check any slight bleeding. In case of subsequent pain during milking, the milk must be removed from the affected quarter by the teat syphon.

Warts on the surface of the udder only require treatment when they interfere with milking. In attempting enucleation, the gland substance must be carefully avoided, and therefore it is well to defer operation until after lactation, or remove the milk by syphon, bearing in mind the precautions mentioned in the section on "Stenosis of the Teat Duct."

In bitches, malignant and other tumours, even if extensively developed, may generally be removed without danger to life. The general rules for such cases are to operate in the loose connective tissue, remove secondary growths as far as possible, and suture the skin, so that after applying a dressing, rapid union may occur. A dose of morphine prevents the animal loosening the stitches. Should primary union not be obtained, the parts are treated as an open wound. The fact that the dog licks the wound usually renders cleansing unnecessary, and healing almost always occurs without difficulty, even after removal of malignant tumours. Secondary growths certainly often occur, but operation may be repeated. Even though recovery is not complete, the owner is often contented if the animal's life is prolonged for a few years.

Up to the present, diseases of the ovary in animals have received little attention; the ovary seldom appears to become inflamed, whilst tumours are usually only discovered on slaughter. Various writers recommend, however, in nymphomania of cattle, to crush or puncture the cysts sometimes met with in the ovaries by operation through the wall of the rectum or vagina.

The radical cure is ovariectomy or oöphorectomy, for a description of which see page 230 et seq.

DISEASES OF THE SPINAL COLUMN AND PELVIS.

I.—FRACTURES, LUXATIONS, AND SUB-LUXATIONS OF THE DORSAL AND LUMBAR VERTEBRÆ. COMMOTIO SPINALIS.

IN the horse, fractures of the dorsal and lumbar vertebræ are not uncommon, either single processes being broken off, or the body and arch of the vertebra fractured. Fractures of the transverse and oblique processes rarely occur apart from injuries to the body of the bone. Fracture of the body is serious, because the cord may be injured, or hæmorrhage into the spinal cord may cause pressure paralysis. Such accidents are commonest in the horse, and may be produced in various ways, but are oftenest caused by the animal getting below some fixed object which prevents it rising. Vertebral fractures may also be caused by collisions, by the animal rearing and falling over backwards, and being violently stopped or started. Fracture of a lumbar vertebra has been seen to result from a horse striking out violently with both hind-feet, from excessive muscular action in galloping, from a collision with a tree, &c., &c. It is still more frequently produced by muscular action when horses are cast, hence such fractures often form complications after important operations. In France and Belgium the general opinion is that fracture is produced at the moment of casting by excessive upward curvature of the spinal column, but German and English opinion inclines to the belief that it most frequently occurs after the animal has been cast and is awaiting operation. A dull, crunching sound is often heard at the moment. Two movements are especially dangerous, and should, if possible, be prevented:—

(1) Violent arching of the back. When the animal's head is carried towards the sternum, the longissimus dorsi is passively extended. If it and the psoas magnus now contract energetically, the pressure on one of the dorsal or lumbar vertebræ may be so severe as to cause comminuted fracture ("crushed fracture") of the body of the bone.

(2) The second action likely to produce this accident is excessive lateral thrust on the spinal column produced by unilateral contraction of the dorsal muscles. It occurs from lifting the hindquarters from the bed, and is probably favoured by anchylosis of the vertebræ

or ossification of the inter-vertebral discs. Ercolani and many others have drawn attention to the predisposing influence exerted, under these circumstances, by bony union of the vertebræ. This is probably the chief reason why old horses so often suffer from fracture of the vertebræ. Such fracture is commonest during dental operations and the castration of thoroughbred horses. The necessity for dental operations is greatest in old horses, whose bones are less resistant than those of younger animals. In castration fracture generally occurs at the moment when the spermatic cord is compressed, and is due to the violent muscular movements. Fractures of the vertebræ occur most frequently when the animal is lying on its side, seldom when on its back; Möller only met with one of the latter, and of Dieckerhoff's fourteen cases only one was produced in the dorsal position.

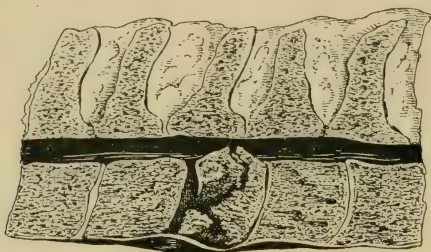


FIG. 448.—Fracture (by crushing) of the body of a vertebra.

Fractures may perhaps be favoured by disease of the spinal column. Thümmeler describes abnormal fragility of the ribs and vertebræ in a ten-year-old mare; Lehnert, a case of vertebral fracture, favoured by necrosis following an abscess. Paltz mentions a case of osteomalacia in a horse; after several minor fractures had occurred, the 3rd lumbar vertebra was broken, with fatal results. On post-mortem examination, all the bones were found excessively soft—the transverse processes of the lumbar vertebræ particularly so. Degive also recognises such a predisposition.

With few exceptions the fracture occurs in the region comprising the last three dorsal and the first two lumbar vertebrae, these bones lying in the middle of the mobile column, which, like a stick, if excessively bent, breaks most readily in the centre. But falling over backwards, and other accidents, may also cause fracture of the 5th, 6th, 8th, or 9th dorsal, or one of the first three lumbar vertebræ.

Vertebral fractures in oxen occur during coitus, fracture in the cow being caused by too heavy a bull, and in the bull by falling. Small animals may be run over, or violently kicked or struck.

Luxation, that is displacement of the articular surfaces, and subluxation (displacement of the vertebra from rupture of the inter-vertebral ligaments), cannot clinically be distinguished from fracture. Voigtländer and Gillmeister saw subluxation between the last dorsal and first lumbar vertebræ in a cow, Thieme in a horse.

Symptoms and course. Fractures of the vertebral processes produce no particular general disturbance. Swelling occurs at the spot, and may sometimes lead to pus formation; while fracture in the region of the withers of the superior spinous processes, which give attachment to certain muscles of the fore-limbs greatly interferes with movement, as Bouley mentioned in describing a case in the horse. The head and neck, and also the back and loins, were held stiffly as in tetanus; the position of the fore-feet suggested laminitis; swelling, pain, and crepitation existed in the region of the withers. The animal could not lie down for a month; and although the ability to move gradually returned, yet for some time the feet were not properly lifted. In fracture of one of the anterior dorsal vertebræ, certain respiratory muscles may be paralysed, but the diaphragm is not affected.

Fractures of the body of a vertebra are generally followed by displacement of the broken fragments and injury to the spinal cord, or by bleeding into the neural canal, and more or less extensive paralysis. Fracture of the last dorsal and first lumbar with compression of the cord is accompanied by paraplegia, with paralysis of the rectum and bladder. The animal cannot rise, and even when able to move the fore-limbs, has no control over the hind. Under some circumstances injury to the spinal cord is delayed, and it is certainly possible for vertebræ to be merely fissured. Many observers have seen cases where the animal could still move, though the back was held stiffly, and where symptoms of paraplegia only occurred after several days. Spinola saw an animal which could still carry its rider and could perform heavy work, though he believed it to be suffering from fissure of a vertebra. Straube describes a horse with a similar fissure, or fracture without displacement, which could nevertheless be hunted and jumped. In rare cases the animals can stand, but cannot move, as when the sciatic nerve is paralysed and the crural escapes. Bombach saw this condition after fracture of the second lumbar vertebra; Möller found functional activity of the crural retained after fracture of the fifteenth dorsal vertebra.

Local examination gives negative results in large and well-nourished horses. Crepitation, pain, or displacement of the superior spinous process of the affected vertebra can seldom be detected, except in small, thin animals with slight muscular development. Paraplegia arising from spinal fracture is accompanied by anæsthesia and sweating behind the lesion, and occasionally a hiatus may be seen over the seat of fracture. Twitching of the dorsal and lumbar muscles and convulsive attacks have also been noticed. Correct diagnosis is the more important because prognosis is always unfavourable, and slaughter must be recommended as soon as fracture of the body or arch of a vertebra is recognised.

In horses, the condition is oftenest mistaken for hæmoglobinuria. The history generally clears up this point, otherwise the urine must be examined, though it should not be forgotten that in hæmoglobinuria the urine occasionally appears normal; the presence of blood, colouring matter, or albumen would, however, point to the latter disease. In hæmoglobinuria the muscles of the loins and quarters are abnormally hard and firm, but in pressure paralysis there is pronounced relaxation. Again, in hæmoglobinuria the visible mucous membranes are more or less reddened, a symptom which certainly does not exist in the early stages of spinal fracture. Diagnosis is more difficult if the animal is unable to rise, or is suffering from fever.

Thrombosis of the posterior aorta or of the iliac arteries produces similar symptoms, but they are intermittent and only shown when the animal is exercised. In doubtful cases, examination per rectum will settle the point.

Fractures of the vertebræ are more difficult to distinguish from injuries to the cord, produced, for example, by violent concussion. In the latter case the cord may be partially ruptured, or extravasation into the subdural space may be produced, without the vertebræ being displaced; finally, concussion of the medulla may exist without visible lesions or anatomical changes, a condition clinically described as *commotio medullæ spinalis*. This has repeatedly been seen in dogs and cats, which have fallen out of windows, or been run over, or struck with heavy sticks. When injuries of this sort are accompanied by rupture of the cord or hæmorrhage into the spinal canal they take the same course as vertebral fractures, and their exact diagnosis is, therefore, of secondary importance. It is otherwise in *commotio medullæ spinalis*, which is generally followed by complete paraplegia. The symptoms due to concussion of the cord may disappear in a few hours, or in eight to fourteen days, and during

this time the hope of recovery should not be abandoned. In many cases, therefore, the diagnosis must be extremely cautious, and an expectant attitude should be assumed. It should be borne in mind that concussion of this kind is rare in the horse, but fairly frequent in small animals like dogs and cats.

Schmaus's observations and experiments show that in concussion of the cord, bleeding, softening, swelling, and degeneration of single axis-cylinders occur. It is evident that the course of such injuries

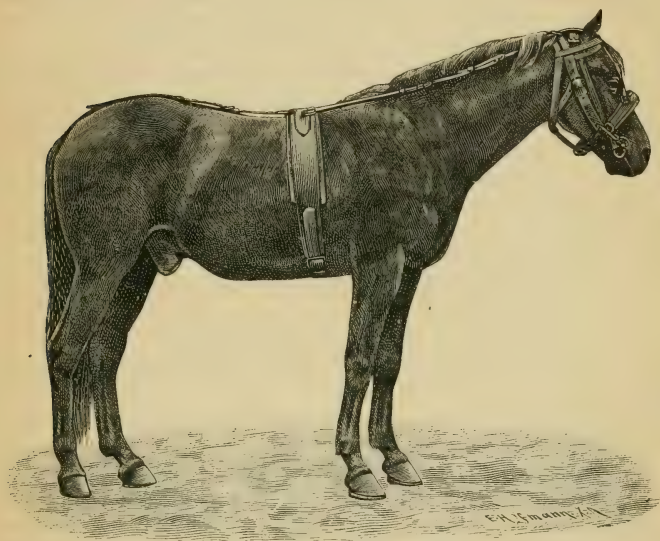


FIG. 449.—Bernardot and Butel's apparatus for prevention of broken back when casting.

depends on the kind and extent of the anatomical changes ; and as these cannot be exactly defined during life, prognosis is always doubtful.

In spinal fracture the last hope of recovery vanishes as soon as paraplegia is complete. Provided the animals can stand, treatment may be attempted, although, as paraplegia may still occur, recovery is uncertain ; Körber saw it set in as late as five days after injury. As, however, the diagnosis in such cases can never be perfectly certain, it is advisable to wait, particularly if the animal's slaughter value is slight, or if it be valuable for breeding. Isolated cases are said

to have recovered, though the descriptions given throw some doubt on the correctness of the observation. But though possible, recovery (in horses) depends on so many circumstances that it can never confidently be anticipated.

In these cases prevention is better than treatment. Stables should be so constructed that animals cannot injure themselves in rising, and great care must always be taken in casting. The first matter is beyond our province; but in regard to the second, the following points should be observed:—In casting the larger animals, a soft bed, preferably of straw, is necessary to prevent fractures. The horse should first fall with the chest towards the earth, and whilst lying the head and neck should be kept extended by powerful assistants. As a further precaution, especially in well-bred horses with strongly-developed muscles, Bernardot and Butel's extension apparatus (Fig. 449), may be employed. The head-collar and girth are connected by thick straps, rendering it impossible for the horse to bend the head and neck beyond a certain point.

Hirzel employs for the same purpose a girth provided with a ring above the animal's back, from which leather straps pass to a strong head-collar. He considers this absolutely prevents any danger of fracture of the vertebræ.

To prevent side-movements of the spinal column when the horse is cast, a man should seat himself on the quarter, and, with the same object, it is well to place the animal with the quarters at a lower level than the feet. In painful operations like castration, particularly in well-bred horses, chloroform should be used. It is also best to avoid castrating aged race-horses when in hard condition, as muscular power is then at its greatest.

In suspected fissure of a vertebra, the animal must be kept from work, and prevented lying down for a month by being placed in slings. In *commotio medullæ spinalis* treatment is expectant. The animals should have a comfortable bed, and be turned from time to time to prevent the formation of bedsores, and the catheter should be passed at least twice a day. In simultaneous paralysis of the rectum, the fæces must be periodically removed; and if the bowels are confined clysters of luke-warm soap and water may be resorted to.

II.—FRACTURES OF THE SACRAL AND CAUDAL VERTEBRÆ.

FRACTURES of the sacrum are commonest in cows, and are caused by external violence, falling on hard objects, or falling from a height, and in the fœtus, by clumsy, violent efforts at assistance during

parturition. Albrecht saw fracture between the sacrum and last lumbar vertebra in a bull after mounting a cow. A horse suffering from fracture of the first and second sacral segments after a collision was seen in the Vienna clinique. In an army horse a fall was followed by fracture of the fourth and fifth sacral segments.

Fractures of the caudal vertebræ in dogs and cats are most frequently produced by the animals being run over or having the tail nipped in a door; in larger animals, by rearing with the tail over the splash board, or by falling over backwards, the tail being extended. To induce oxen to move, the tail is sometimes violently twisted, with the result that the caudal vertebræ are fractured. In the tail region the inter-articular cartilages are sometimes torn through. Treatment is very similar to that of fracture.

Symptoms and course. The lumbo-sacral plexus, provides the muscles of the hind limbs with motor fibres, and fracture of the first sacral vertebra or of the lumbar vertebræ is therefore followed by partial or complete paralysis behind the lesion. The nerves which leave the vertebral canal through the third and fourth sacral notches, give motor and sensory fibres to the rectum, penis (*N. dorsalis penis*), and perineum. Fractures of the sacrum are therefore always attended with paralysis of the tail and rectum, and sometimes of the bladder, in addition to paralysis of the muscles of the hind-limbs. The symptoms depend on the position of the fracture and the changes consequent on it. The fact that blood is often poured into the vertebral canal, explains why fractures occurring further backwards than the last sacral vertebra are often attended with extensive disturbance. Most fractures of the sacrum in cattle are accompanied by weakness in the hindquarters, some with complete paralysis. The fragments of bone are generally displaced, voluntary defæcation is always and urination sometimes impossible. Fractures of the caudal vertebræ only paralyse the tail when the first vertebræ are affected. The tail is generally exceedingly mobile, and crepitation may be audible; not infrequently the skin is injured (compound fracture); sometimes the end of the tail remains hanging by a few tendinous shreds of the caudal muscles.

So long as an animal with fracture of the sacrum is able to stand recovery may occur, but cure is out of the question in complete paraplegia, especially in horses; in cattle and carnivora paraplegia renders prognosis doubtful. Paralysis of the urinary bladder is a very unfavourable symptom, as, on account of the necessity for emptying the bladder by catheter, infection may occur, the urine decompose, and severe cystitis set in. A cow, however, with paralysis

of the rectum, consequent on displacement between the first caudal and last sacral vertebræ, recovered completely (Harms). Fractures of the upper caudal vertebræ may also cause deformity and limitation of movement in the tail. Möller saw a calf in which, in consequence of fracture, the tail was twisted to one side and could no longer be freely moved. Compound fractures of the tail vertebræ are readily followed by necrosis; this always happens when the vertebræ are crushed; the tail then feels cold, showing that the blood-vessels are obstructed. Permanent paralysis is another frequent consequence, and is especially troublesome, because the tail becomes soiled by the fæces, and in cows by the urine.

An army horse, the subject of fracture between the fourth and fifth sacral vertebræ, showed a swelling as large as a man's fist over the sacrum, and suffered from rolling gait, paralysis of the tail, and difficulty in passing fæces. After five weeks' rest in slings, the swelling increased to the size of a child's head, and became harder; seven months later the animal could carry a light rider; but as sacral paralysis gradually set in, the animal had finally to be killed. Post-mortem examination revealed the presence of a callus as large as a child's head, and fresh bleeding into the vertebral canal.

Treatment. Treatment is seldom justifiable in fracture of the sacrum accompanied by complete paralysis, but in other cases the rectum and bladder must be frequently emptied. In repeatedly using the catheter, the precautions recommended under "Diseases of the Urinary Organs" must be borne in mind.

Fractures of the caudal vertebræ, with severe local bruising or crushing, necessitate amputation of the tail; in compound fracture it is generally the quickest method of cure. Only in valuable horses is it worth while resorting to antiseptics or the application of dressings.

III.—CURVATURE OF THE SPINE.

THE most frequent form of this disease is hollow-back, a condition known as lordosis.¹ Curvature upwards is called kyphosis,² and towards the side skoliosis.³ Simultaneous curvature upwards and sideways is termed kypho-skoliosis.

One class of these abnormalities arises during intra-uterine life. Animals born crippled are generally at once killed. Marked curvature of the spine, immediately after birth, has been often seen in pigs; Rehms noticed curvatures (hump-back) in rickets. Pigs

(¹) λόρδωσις=curvature.

(²) κίφωσις=crookedness.

(³) σκολίωσις=crookedness.

also suffer from curvature of the spine in consequence of being trodden on by other occupants of the sty. Pütz describes kypho-skoliosis in an eighteen months' foal. The dorsal vertebræ were bent towards the right, the lumbar vertebræ towards the left, and the back was depressed in places. The condition described by Preusse (kypho-skoliosis) in a foal appears to have been congenital. Vives noticed a horse in which the lumbar vertebræ were bent downwards almost at a right angle, and the thorax and abdomen were so depressed that the latter almost touched the ground. A tree had fallen on the animal's back, causing symptoms of vertebral fracture. After some time recovery took place, but the vertebral column remained bent.

The causes of spinal curvature cannot always be identified, but those usually accepted are congenital deformities, conditions resulting from spinal fractures and luxations, rickets, osteomalacia, tuberculosis, and local diseases of the spine.

The first are of the greatest interest, and are typified in the horse by lordosis. Although little amenable to treatment, this condition has a special interest from the prophylactic point of view.

Lordosis develops during the first years of life, though occasionally it appears later. The predisposing cause is weakness due to abnormal length of the back. The extrinsic causes include all influences leading to continuous or excessive strain on the spinal column. Amongst these are the weight of the rider, distension of the colon by bulky food, or enlargement of the uterus consequent on pregnancy; old mares which have bred regularly frequently show lordosis. The collective result is to bend the spinal column downwards. The inferior surface of the spine becomes extended, the superior surface curved or compressed. In young animals the lower portions of the vertebræ grow, while in the upper part growth is checked by the increased pressure, and therefore, in time, the spine tends more and more to assume that particular form. This explains why in man work leads to kyphosis, in animals to lordosis. Special disease processes, like rickets, may favour the development of such deformities, but at present are little understood in animals.

A second factor in the production of spinal curvature is local disease of the vertebræ. The greatest number of cases have been seen in oxen as a result of tuberculosis. Morot described twenty. Hess in a steer saw kyphosis in consequence of tuberculous disease between the second and third lumbar vertebræ.

A twenty-five year old horse which had suffered for many years, and in increasing degree, from hollow-back was found on post-mortem to have

marked convexity of the spine, extending as far as the third lumbar vertebra. The aorta, which was aneurysmal and had very thin walls, followed this curvature; the articulation between the last lumbar vertebra and the sacrum showed signs of arthritis. The centres of the intra-vertebral cartilages, between the dorsal and lumbar vertebræ, had disappeared; their circumferences were ossified, and exostoses existed both in the vertebral canal and on the under surface of the bones. The superior spinous processes of the dorsal vertebræ also showed signs of rarefying osteitis, which had diminished movement. The bodies of the lumbar vertebræ were firmly united by bony material.

Symptoms and course. Only when the above described changes become greatly developed do they excite attention. The rate of development of lordosis is very varied. When it appears suddenly it may be followed by difficulty in respiration. As a rule, however, it occurs gradually, and only in exceptional cases becomes so well marked as to interfere with the animal's usefulness. Most of the dorsal and lumbar vertebræ are usually involved in the curvature. Where single vertebræ are diseased, flexion develops slowly, whereas that resulting from fracture is of sudden onset. This fact generally enables the nature of the disease to be distinguished.

Treatment. In animals reduction of displaced vertebræ is seldom possible. The only means (orthopædia) is difficult and tedious, so that results are robbed of their value by the time and expense involved. Prophylaxis is more important, especially in foals. Up to a certain point lordosis can be prevented, by proper precautions. Young horses with long backs should never be heavily loaded. It is best to give concentrated food, and to place it in low mangers or on the ground. Grazing exercises a beneficial influence, on account of the back having to be bent upwards as the animal crops the grass. Distortion following suppurating osteitis of one or more vertebræ is occasionally seen in animals, including the horse. The first cause is usually a deep-seated abscess, or a wound implicating the vertebral column. Treatment then consists in puncturing the abscess, removing loose fragments of bone, and continuously irrigating the parts with a disinfectant. So long as no signs of paralysis occur there is hope of recovery, though such cases are always prolonged and wearisome. Fractures and luxations may also be responsible for spinal curvature, but as the animals are usually killed, such cases seldom have an opportunity to develop. Finally, disease of the intra-vertebral discs may cause deformity.

IV.—FRACTURES OF THE PELVIS.

FRACTURES of the pelvis are commonest in the larger animals, particularly in horses, and are caused by falls on smooth pavements, by collisions, sometimes by the animal's legs slipping from under it, or by the horse making a sudden turn when being ridden. Since asphalt has been extensively laid down fractures of the pelvis in horses have greatly increased in frequency and often occur even without the animal falling. Trasbot saw fracture of the ilium in a race-horse produced while galloping. The pelvis may also be fractured by casting the horse on hard ground, if the pelvis fall first ; the animal's chest should first touch the bed. Stockfleth noted a case of fractured pelvis from violent struggling in hobbles. Fractures of the outer angle of the ilium are also caused by passing through narrow doorways, by kicks or by heavy objects falling on the bone ; the skin is often simultaneously injured and a compound fracture results ; with few exceptions, other pelvic fractures remain subcutaneous. In the mare, however, Möller saw perforation of the vagina by a splinter of the ischium.

In cows fractures of the pelvis may be caused by violent attempts to effect delivery. Similar injuries occur during coitus and after falls.

Whilst in large animals the weight of the body or violent muscular action is responsible for these fractures, in dogs and the smaller animals they generally result from external violence, as from being run over, severely kicked, or crushed in narrow passages or in doorways. This explains why multiple fractures of the pelvis are frequent in small animals, but comparatively rare in large ones.

For the purpose of diagnosis and prognosis, fractures of the pelvis may be divided into two groups :—

(1) Pelvic fractures without division of the pelvic girdle (Fig. 450). These comprise fractures of the external (1) or internal (2) iliac angle, fractures of the tuber ischii (6), transverse portion of the os pubis (4), and external portion of the ischium (4a). The external angle of the ilium is the most frequent seat. It need scarcely be said that such injuries are less grave than the following group, though they may, nevertheless, cause incurable lameness—as, for example, when they involve the acetabular margin of the hip-joint. Jess mentions a case where a horse fell several times and then suddenly died. On post-mortem examination the tuberosities of the ischium were found to be broken, the posterior portions of the bodies of the pubic bones and the shaft of the ilium fractured. Death had resulted from hæmorrhage.

(2) Fractures of the pelvis with division of the pelvic girdle. These include fractures of the shaft of the ilium (3), through the cotyloid cavity (5), through the obturator foramen, *i.e.*, simultaneous fracture of the oblique branch of the os pubis and of the external branch of the ischium (4 and 4a), and finally, fractures through the os pubis and os ischii, parallel to the symphysis pubis (7). Multiple or comminuted fractures of the pelvic bones sometimes occur. Fracture of the ilium complicated with fracture through the obturator foramen is often seen; and one reported case showed simultaneously double-sided fracture of the inner angle of the ilium and fracture

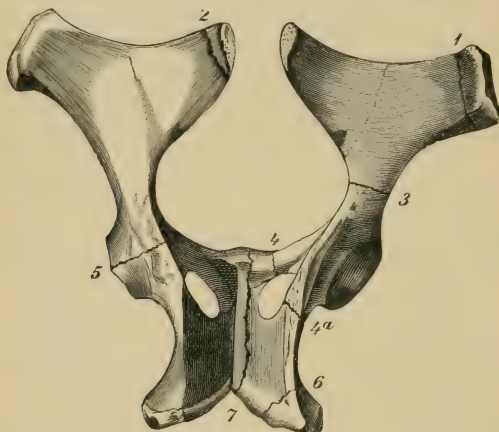


FIG. 450.—Schema illustrating fractures of the pelvis in the horse.

Fracture of (1) external iliac angle; (2) internal iliac angle; (3) shaft of the ilium; (4) transverse portion of the os pubis; (4a) external portion of the ischium; (5) cotyloid cavity; (6) tuber ischii; (7) symphysis pubis.

of the femur. It must not be forgotten that such multiple fractures do not always occur together, but may only be developed by moving the animal. Immediately the pelvic girdle is divided, there is danger of further fracture occurring from the entire weight being thrown on the diseased side; this is commonest after injury to the inner angle of the ilium. Huth saw one case, post-mortem, with four completely united fractures.

Symptoms. Diagnosis of fractured pelvis is easy when crepitation exists. Otherwise careful search is required, including examination by the rectum or vagina. The most important symptoms are:—

(1) Lameness. This sets in suddenly, is seldom absent in recent

pelvic fracture, but varies greatly in degree. In fractures in front of the cotyloid cavity, particularly in fracture of the external angle of the ilium, there is marked interference with movement of the affected limb, and its forward stride is shortened. This is ascribable to the fact that one of the muscles extending the thigh is attached to the external angle of the ilium. Similar lameness is noticed in some fractures of the tuber ischii. In either case equal weight is placed on each foot. Fractures behind the cotyloid cavity with division of the pelvic girdle produce marked lameness when weight is placed on the leg (supporting leg lameness),¹ those into the cotyloid cavity produce lameness, both when the leg is carried and when weight is placed on it (mixed supporting and swinging leg lameness). In fractures of the ischium and pubis there is often a tendency to place the thigh in a position of abduction. Even when these fractures are uniting, supporting leg lameness with abduction of the thigh is not infrequent. In fractures into the cotyloid cavity, especially when complicated with rupture of the ligamentum teres, the thigh is more or less relaxed, whilst during one stride the foot is abducted, and during the next adducted, causing the animal to stumble.

Supporting leg lameness also follows fracture of the foramen ovale and of the transverse branch of the os pubis. In three cases seen by Möller lameness was absent: once in a fracture of the transverse branch of the os pubis, once in fracture through the os pubis and os ischii parallel to the public symphysis, and once in fracture of the external branch of the os ischii. The two latter fractures may not produce lameness; if then the animal is worked, the pieces of bone are repeatedly thrust apart, and union is attended with great difficulty, or may never occur.

Nocard describes a peculiar lameness consequent on fracture through the foramen ovale. The foot was advanced stiffly (*tout d'un piece*), the thigh alone was normally moved, whilst the other parts of the leg seemed passively to follow it. The foot described a circle outwards, the stride being greatly shortened. This lameness, which Nocard ascribes to pressure of the callus on the nerve in the obturator foramen, shows a great similarity to that described by Möller as paralysis of the internal popliteal or of the obturator nerve. It is not surprising, under the circumstances, that the nerve should suffer disturbance of function.

¹ I have, somewhat reluctantly, introduced two new terms into English veterinary phraseology. German veterinary surgeons employ two very convenient words, which have no equivalent in English, to differentiate lameness most marked when weight is thrown on the limb, and lameness most marked when the limb is carried. The former term is in German *Stützbeinlahmheit* (literally, "supporting leg lameness"), the latter *Hangbeinlahmheit* (literally "hanging or swinging lameness"). [Jno. A. W. D.]

A mare had fallen six days before, and on being brought for examination showed marked supporting leg lameness and abduction of the thigh. In this case the right hind-foot was abducted even when at rest. On post-mortem, a fracture was found involving the inner and outer branches of the os pubis, and extending over the symphysis pubis to the opposite side. The outer branch of the right ischium was fractured close behind the capsule of the joint, the inner branch was divided from the os pubis, from which point the fracture extended forward towards the symphysis pubis.

In a gelding, slight lameness, accompanied by very distinct crepitation, occurred after a fall. Even when trotted, the only point observable was slight stiffness of the back and moderate abduction of both hind-feet; but by placing the hand on the quarter and causing the slightest movement, distinct crepitation could be produced. Examination per anum showed the case to be fracture parallel to the symphysis pubis.

(2) Crepitation. This is particularly noticeable in fractures of the pelvis with division of the pelvic girdle, and may be audible at the stifle or even several steps away. In fractures of the ischium and pubis it is less marked, though sometimes quite audible; in those of the external and internal angles of the ilium it is absent. In making the examination, one hand is placed on the outer angle of the ilium, the other on the buttock in the region of the tuber ischii, and attempts made to move the rump from side to side so as to throw the weight from one hind-foot to the other, or the hand is placed on the outer angle of the ilium and the horse made to move. In mares and cows, crepitation, especially in fractures of the pubis and ischium, can be felt from the rectum or vagina by laying the hand on the pelvic floor, and as the sensation is better conveyed by the bones than by the soft parts, it is best to examine from this point. Very slight crepitation can also be detected by applying the ear against the quarter. When the animal is lying down, crepitation may sometimes be produced by pressing on the outer angle of the ilium, or by moving the hind-leg forwards; the latter is more successful in fractures of the tuber ischii.

In fractures extending through the cotyloid cavity, crepitation can even be heard when the horse is standing by merely pressing on the muscles of the quarter, or by causing weight to be placed on the affected leg. This is explained by the fact that the muscles of the quarter are inserted partly in front of and partly below the point of fracture, and in contracting, displace the pieces of bone—a symptom that is of value both in prognosis and diagnosis. Crepitus may be absent within a few hours after the accident from the presence of blood clot, muscle, or other tissue between the broken parts.

(3) Deformity of the quarter is, as a rule, best marked in fractures of the ilium. In fracture of the outer angle, the loose piece of bone is drawn forwards and downwards by the oblique abdominal muscle, and by the tensor vaginae femoris and lies towards the abdominal wall, so that the outer iliac angle seems to have disappeared. To detect this, the animal is placed with the hind-feet level, and the observer standing behind, compares the relative contours of the outer iliac angles. The larger the broken portion, the more marked, of course, will be the asymmetry.

In fractures of the shaft of the ilium, the entire ilium, and especially its outer angle, sinks; this symptom can almost invariably be detected if the horse be made to stand equally on both feet.

A peculiar change in form follows fracture of the external branch of the ischium; the buttock is flattened at the height of the tuber ischii, whilst the region of the hip-joint appears considerably swollen, and the ilium slightly depressed. The abnormality is discovered by standing a few steps behind the animal and regarding the pelvis. Fractures through the acetabulum or os pubis are not generally followed by changes of form in the quarters, though in fracture of the acetabulum a depression may sometimes be seen over the hip-joint.

(4) The bones of the pelvis are seldom abnormally mobile, except when the external and internal angles of the ilium are simultaneously fractured, though in exceptional cases mobility is present after fracture of the shaft and body of the ilium, or of the ischial shaft. In such cases the outer angle of the ilium yields when pressed on, and crepitus may sometimes be detected.

(5) In fractures of the pubis, œdematous swelling sometimes occurs under the belly in the region of the udder or scrotum, but its absence does not exclude the possibility of such fractures. Fractures of the os pubis are often followed by swelling about the vagina; fragments of the pubis or ischium may penetrate the vagina and produce bleeding from the vulva. After fractures of the tuber ischii, swelling may also occur in the neighbouring thigh muscles. On the other hand, in fractures of the ilium, excepting the outer angle, swelling is seldom externally visible, but can be discovered by rectal examination.

(6) Unusual mobility of the thigh. All fractures which divide the pelvic girdle behind the cotyloid cavity, as well as fractures into the acetabulum, with relaxation of the ligamentum teres, are characterised by abnormal freedom in abduction, sometimes also in adduction, of the thigh of the affected side.

(7) Examination per anum or per vaginam affords further information in fracture of the ilium, ischium, or pubis, particularly when the shaft is broken. Local swelling can be detected; and if the animal's quarters be moved to and fro, a hand inserted in the rectum easily follows the displacement of the fractured bone.

(8) In fractures of the pelvis as in other fractures, fever may occur, or symptoms of bleeding from injury to blood-vessels. This danger is perhaps greatest in fracture through the obturator foramen. The following are the distinctive symptoms of the most commonly-occurring fractures of the pelvis:—

(1) Fractures of the external angle of the ilium (Fig. 450—1, deformity, adduction of the stifle, swinging leg lameness, absence of crepitation, sometimes swelling and pain on pressure.

(2) Fracture of the shaft of the ilium (3). Depressed position of the affected quarter. Swinging leg lameness, crepitation when standing on the foot of the affected side. Examination per anum gives more information. This fracture may also occur in cows during difficult parturition or after falls.

(3) Fracture through the acetabulum (5). Marked swinging leg and supporting leg lameness, often accompanied by painful groaning. Crepitation without moving or placing weight on the limb, deformity slight, sometimes sinking of the great trochanter and abnormal mobility of the hip-joint.

(4) Fracture through the obturator foramen (4 and 4a). Supporting leg lameness, crepitation, no deformity, sometimes paresis; if obturator nerve implicated, there is marked abduction of the limb.

(5) Fracture of the os pubis near the symphysis (4). Supporting leg lameness, with a tendency to abduction of the limb, pain on forced abduction in moving backwards or sideways. Crepitation sometimes absent, sometimes slight, sometimes distinct. Swelling below the abdomen may be wanting. Examination per anum gives further information.

(6) Fracture of the ischium (4a); of the tuber ischii (6). Swinging leg lameness, swelling of the vagina or rectum, frequently of the muscles of the thigh. After union is complete the gait often remains shuffling, the feet being dragged and the toes excessively worn, as in animals suffering from partial lumbar paralysis. Deformity of the point of the buttock sometimes exists, the latter when seen from behind appearing abnormally broad; when from the side, less prominent than the sound buttock. Crepitation on moving the hind limb.

(b) In fracture of the shaft of the ischium (4a), the vagina may

be perforated, and bleeding occur from the vulva. Crepitation on moving the affected limb is often marked. Slight lameness, or (if the pubis remain intact) absence of lameness, accompanied, however, by crepitation, points to fracture of the hinder portion of this bone, especially if the above-described deformity of the buttock exists.

A knowledge of these symptoms, assisted by careful rectal or vaginal exploration, will in the larger animals usually ensure accurate diagnosis, not only of the position but also of the extent of fractures of the pelvis. When crepitation is marked and the femur known to be intact, broken pelvis can be confidently diagnosed. In small animals examination by Röntgen rays is very useful.

The prognosis varies exceedingly, according to the position and extent of the fracture and the nature of existing complications. The danger increases somewhat in the following order:—

(1) Fractures of the angles of the ilium. In fracture of the internal angle, provided the pelvis does not separate from the sacrum, movement is not interfered with and recovery always occurs. The significance of fractures of the external angle depends on the size of the broken portion and the amount of deformity of the quarter. When only one of the tuberosities is broken, lameness usually disappears completely in three to six weeks; and even after fracture of both prominences or detachment of a large piece of bone, the lameness may also subside in six to ten weeks but not infrequently recurs owing to abscess formation and necrosis of the loose bone. Fractures involving the flat portion of the ilium may sometimes permanently interfere with movement, the swinging leg lameness that remains preventing the animal going beyond a slow walk. Compound fractures of the ilium, *i.e.*, those associated with injury to the skin, generally reunite under proper treatment, though sometimes only after a considerable time (six to ten weeks). The form of lameness frequently described as rupture of the *M. tensor fasciæ latae* may perhaps be sometimes due to fracture of the external angle of the ilium.

Pfeiffer saw a horse with fracture of the internal angle of the ilium; the fractured part was as large as a cheese plate. The animal showed severe lameness whilst the leg was swinging forward.

(2) Fracture of the shaft of the ilium without much displacement may in quiet animals be followed by complete restoration to usefulness; otherwise lameness remains, or continually returns after severe exertion, and restricts the animal to slow work. As the result

depends on the amount of displacement and the nearness of the fracture to the joint, prognosis should be preceded by rectal examination. Prognosis is, however, generally doubtful, and is the more unfavourable the more patent the deformity of the croup, the greater the depression of the ilium, and the nearer the fracture to the acetabulum. Marked atrophy of muscle is also an unfavourable symptom. Stockfleth saw continuous lameness due to formation near the joint of a large callus, which interfered with movement of the upper trochanter.

(3) Fractures of the acetabular branch of the os pubis and of the ischial shaft are also grave. Union proceeds slowly, and often remains incomplete, resulting in the formation of a callus fibrosus; fractures of the pubis often recur, especially if the animal soon afterwards becomes pregnant. Fracture of the ischial shaft (4a) often fails to unite, and the animal is only of use for slow work. In a case of Möller's there was still marked crepitation after eight weeks, but complete union occurred in four months, and the animal could be put to trotting work. The fact that pain is not severe favours movement and displacement of the fragments, and interferes with recovery.

(4) Extensive fractures of the tuber ischii usually unite very slowly, and sometimes result in the toe being dragged and the *M. biceps femoris* thrust out of position during movement; small fractures may be overlooked, lameness being absent.

(5) Fractures through the obturator foramen are dangerous on account of the risk of injury to blood-vessels and of serious bleeding. Permanent lameness may result from the obturator nerve being involved in the callus. Otherwise they are rather more hopeful than the following, because, though rare, yet union may occur, and the animal become capable of work.

Division of the pelvic girdle close to the symphysis pubis and parallel with it sometimes produces little disturbance; but union is always slow and incomplete, while in many cases it fails to occur. Laser saw a case where the bladder had been nipped between the pieces of bone. Such fractures tend to recur, especially if the animal be moved too early, or give birth to a foal.

(6) Fractures of the acetabulum are the most dangerous, because as a rule the wall of the cotyloid cavity is broken into several pieces; prognosis is generally unfavourable, though exceptionally union is well effected, enabling the horse to resume work.

Fracture of the pelvis through the sacro-iliac symphysis is generally incurable, the danger being that, although only one side

may be at first affected, the body-weight is apt to break down the union between the sacrum and the ilium on the other side, or that the inner angle of the ilium may become fractured; the animal is then unable to stand. Complete fracture through the ischio-pubic symphysis in horses also appears to be incurable.

Treatment. If treatment is attempted, complete rest is a primary necessity. In most fractures of the external angle of the ilium, it is sufficient to keep the animal from work for a time; if unable to stand on the foot of the affected side, the patient should be slung. In some pelvic fractures (acetabulum, iliac or ischial shaft), the precaution of slinging the patient is very necessary, because of the grave risk of further displacement of the broken parts should the horse lie down. Cases complicated by abscess, sinus formation, or necrosis should be treated according to general surgical principles. Perineal or pelvic sinus following pubic or ischial fracture with necrosis is nearly always incurable; the source of the pus cannot be effectually treated, and though the horse may be free from lameness and quite workable the tail and thighs during fast work are constantly soiled with offensive discharge.

In uncomplicated pelvic fractures patients, after resting six to eight weeks, may be moved cautiously, but if unable to bear weight on the foot of the affected side, they should be returned to slings. Stiffness in movement is less important, because it depends to some extent on the long rest, and gradually disappears with exercise. Provided pain is not excessive, the muscles of the quarter and thigh may be massaged to prevent that rapid atrophy which follows severe lameness. Daily kneading of the parts will promote nutrition of the muscles. Atrophy, being only due to inactivity, disappears with return to regular work. An adhesive plaster or a charge is often applied to the affected quarter with the object of restraining movement. For this purpose and perhaps to hasten the ossifying process some veterinary surgeons use blisters.

V.—DIASTASIS OR LUXATION OF THE SACRO-ILIAC ARTICULATION.

THE union between the sacrum and ilium on each side is formed by a stiff, almost immobile, joint, the short capsular ligament of which envelops the whole articulation. The superior and inferior sacro-iliac ligaments, assisted by the sacro-sciatic ligament, contribute to this union.

In horses, this ligamentous apparatus unites the bones so firmly that they are very seldom dislocated, it being easier to break the

ilium. In cattle the union is less firm, the upper sacro-iliac ligament being sometimes absent. For this reason these animals occasionally suffer incomplete or complete separation of the sacrum from the ilium, especially during parturition. Stockfleth and Berdez have thoroughly studied the condition, and their description is here followed. Berdez, considering the mode of origin of this dislocation, lays particular stress on the atony of the abdominal muscles which occurs at the time of parturition. Of these the rectus abdominis appears to act in opposition to the ligamentous apparatus described, and fixes the joint. When, therefore, it is relaxed as during parturition, danger of displacement becomes imminent. Stockfleth believes that movement in the symphysis pubis favours displacement. If division occurs in the symphysis pubis, the sacro-iliac joint is endangered, hence the simultaneous occurrence of the two conditions as related by Golis. It will also be clear that dislocation on one side may readily lead to a similar accident on the other. It is even the rule to meet with double-sided dislocation, as noted by Albrecht, Guillebeau, and others.

According to Stockfleth, incomplete luxation is often occasioned in pregnant cows by pulling on the tail to assist them in rising, and complete luxation then follows. It may also be caused by violent muscular exertion. The *psoas magnus* and *longissimus dorsi*, with a group of the thigh muscles, draw the sacrum downwards, whilst the *glutei* and other muscles of the thigh move the inner angle of the ilium outwards. Powerful contractions in these muscles, produced by the animal rising or walking, may thus occasion dislocation of the bones.

In incomplete luxation, the union between ilium and sacrum is not completely broken down. The muscles are partly torn through, and become infiltrated with blood, but the ligaments are only partly divided. In complete luxation, on the other hand, all the ligamentous structures are ruptured, and the sacrum sinks between the inner angles of the haunch, its anterior portion especially, so that the articular surfaces may sometimes be 1 to 2 inches below the inner angle of the ilium. In consequence, the abdominal organs are compressed and sometimes injured; even the passage of *fæces* may be interfered with.

Symptoms and course. After complete dislocation, the animal is inclined to rest continuously, rises with difficulty, and when moving takes short stumbling steps with the hind-legs. Sometimes large quantities of *fæces* are passed, a symptom which Stockfleth considers characteristic of dislocation. Pressure between the inner angles

of the ilia produces pain, and the separation can sometimes be felt through the rectum.

Complete luxation is characterised by marked depression of the sacrum, and by the anterior edge of the ilium being unusually sharply defined. The swelling and tenderness in the middle line, and the inability to rise or to stand, render the condition unmistakable. On examination per rectum, the pelvic cavity is felt to be narrowed, both in its perpendicular and transverse diameters. Defæcation is sometimes interfered with, in consequence of compression of the rectum.

In incomplete dislocation, recovery may occur in three to four weeks, but double-sided dislocations take much longer, and many never reunite. Paraplegia generally sets in on the second or third day. The patient is unable to stand, and if parturient, will require active assistance, because labour pains are generally weak.

According to Stockfleth, complete luxation is less to be feared, for the animals sometimes recover sufficiently to be useful for dairy purposes, even though, on account of the narrowness of the pelvis, they cannot be bred from.

Treatment is essentially similar in both conditions. In incomplete luxation, rest is above all else necessary. Where there is difficulty in rising, assistance must be afforded, but the tail should never be used for this purpose; assistance is also required during parturition.

Complete luxation also calls for a lengthened rest, and cases always do best if the animals lie continuously. Plenty of straw should be allowed, and help only afforded if the animal attempts to rise. The patient must not be driven for at least two to three months, nor again used for breeding. Complications often occur during recovery, and carry off the animals.

VI.—LUXATION OF THE SYMPHYSIS OSSIIUM PUBIS.

THIS luxation, almost invariably confined to cattle, is still rarer than the last named. The luxation most commonly appears during or as a sequel to parturition. Golis saw it in connection with luxation of the sacrum.

An eight-year-old cow, nearly at full term, suddenly became lame during work, and a few hours afterwards could neither rise nor, when lifted, stand on her hind legs. On attempting to move, the inner angle of the ilium on the affected side rose and sank. Displacement of the pubis and ischium at the symphysis could also be felt. The cow was slaughtered, and the post-mortem showed luxation of the sacrum and separation of the bones forming the symphysis pubis.

Prietsch saw a similar accident in a two-year-old heifer, which slipped with her hind-legs on a smooth pavement. The animal was unable to rise, and on post-mortem the symphysis pubis was found separated throughout its entire length.

In horses, the symphysis pubis becomes completely ossified, and therefore in them fracture is commoner than separation.

The diagnosis becomes absolute on examination per anum. The incurability of the disease renders immediate slaughter advisable.

VII.—HYGROMA OF THE SUBCUTANEOUS BURSA OF THE TUBER ISCHII IN CATTLE.

In cattle, which often rest with the hind-quarters against walls, &c., chronic dropsy of the subcutaneous bursa on the point of the ischium has been observed. A longish, ill-defined, painless, or only slightly painful, fluctuating swelling the size of a man's fist or even larger, develops on the point of the buttock, and on incision discharges a serous fluid.

In some recorded cases an incision about 3 inches long was made, the contents were removed, and a tampon of tow saturated with iodine tincture was inserted. Recovery occurred in two months.

VIII.—PARALYSIS OF THE HIND EXTREMITIES. PARAPLEGIA.

PARALYSIS means partial or complete loss of muscular contractility from disorders of motor innervation. According to the seat of the causal lesion, paralysis may be cerebral, spinal, or peripheral. It varies in degree from simple muscular weakness or incomplete loss of power (paresis) to complete loss of motion and sensation. Monoplegia is paralysis limited to one limb, a group of muscles, or a single muscle, and hemiplegia is applied to paralysis of one lateral half of the body. Paraplegia, or bilateral paralysis, affects the hind-quarters and limbs, and sometimes involves all four extremities.

Central (cerebral or spinal) paralysis may arise from injuries (fractures, dislocations), hæmorrhage, infective diseases (rabies, distemper, dourine, strangles, &c.), toxins, local disease, tumours, parasites, mineral or vegetable poisons. Peripheral paralysis may result from contusions, wounding, compression, neuritis, fracture, rupture, &c.; occasionally there is no discoverable lesion. As a rule in animals paraplegia indicates disease or injury of the spinal cord; very rarely it is the result of brain disease. Two forms, complete and incomplete paraplegia are recognised. The former is seen :—

(1) In injuries with compression or bruising of the spinal cord, as in some fractures of vertebræ in the dorsal, lumbar, or anterior sacral region (see Fractures, &c.). Hess saw paraplegia in a bull caused by necrosis between the first and second lumbar vertebræ. The spinal column presented an elbow directed upwards, and the vertebral canal had become narrowed. As the animal was suffering from tuberculosis of the epididymis these changes were regarded as tuberculous. Stroese saw a case of pachymeningitis spinalis interna purulenta in a cow, caused by streptococci and bacterium coli communis. Matthiesen identified as the cause of paralysis of the hind-quarters in a cow an actinomycotic growth, which, growing from the condyloid foramen, had exerted pressure on the medulla oblongata. Dorrwächter found a sarcoma of the first dorsal vertebra in a cow. In a horse which, after falling, had shown gradually progressive paralysis from behind forwards, Fröhner discovered a circular belt of connective tissue surrounding and strangulating the spinal cord between the fourth and fifth cervical vertebræ.

(2) In inflammation of the spinal cord and its membranes in the regions indicated, usually a sequel of some other disease, especially of fevers or infectious diseases like influenza, strangles, or distemper. The enzootic paraplegia, so common in America, belongs to a group of infectious diseases which are constantly in evidence in some countries. Paraplegia is also one of the symptoms of sunstroke.

On the other hand, that form of paralysis affecting the hind-quarters during hæmoglobinuria is dependent less on change in the spinal cord than in the muscular tissue. The fact that hæmoglobinuria is always accompanied by paralysis of the hind-quarters has not only led to the incorrect description "rheumatic paraplegia," but also to the erroneous view that disease of the kidney may produce paraplegia.

Idiopathic inflammation of the spinal cord and of its membranes has also been seen in horses. Friedberger found two areas of softening a little in front of the lumbar swelling of the spinal cord, and a watery fluid in the sub-arachnoid space in an eighteen to twenty year old horse which for some days had been affected with incomplete paraplegia, and later had shown symptoms of paralysis about the head (lips and tongue). Dieckerhoff describes a case of meningitis spinalis purulenta in a horse. Axe discovered, on making a post-mortem of a horse which, after recovering from strangles, had suffered from paraplegia, œdema and capillary hæmorrhage in the pia mater spinalis and infiltration of the spinal cord with pus corpuscles, whilst the spinal column itself was quite intact; possibly

in such cases metastasis may sometimes have occurred. Johnne reports having seen hæmorrhagic pachymeningitis and leptomeningitis of the lumbar portion of the cord in a horse which, whilst standing in the stable, became completely paralysed in its hind-quarters, and died twenty-four hours later. The spinal cord was more than half torn through between the first and second lumbar vertebræ, though the vertebræ themselves were free of injury. The epizootic paraplegia described in books is probably to a great extent only hæmoglobinuria. This seems also true of the condition which Comény saw in isolated horses of a troop, and which appeared mostly to affect mares. Signol reports an epizootic form of paraplegia amongst horses of Arabian blood, which also generally affected mares. The post-mortem gave no indications of the cause.

In dogs affected with paraplegia, anæsthesia of the hind-quarters and paralysis of the bladder, Kitt and Stoss found circumscribed pachymeningitis externa chronica, with formation of cartilaginous material, thickening of the dura, dilatation of arterioles, excess of spinal fluid, leading to distension of the dura mater; though in the spinal cord itself no change whatever could be detected.

(3) In consequence of tumour formation in the vertebral canal. Pfister found in a cow, which had shown gradually increasing symptoms of paraplegia, a lipoma $3\frac{1}{4}$ inches long and $1\frac{1}{4}$ thick in the anterior end of the sacral portion of the vertebral canal, which was dilated, whilst the spinal cord appeared flattened. Johnne detected meningomyelitis tuberculosa in the spinal cord of an ox, whilst in a horse which had died with symptoms of paraplegia, Hertwig found a melanotic tumour. It had originated in the lymph glands in the lumbar region, partly destroyed the last three lumbar vertebræ and the sacrum and penetrated the vertebral canal.

(4) As a secondary symptom, paraplegia accompanies general paralysis caused by meningeal inflammation and other inflammatory changes in the brain, medulla oblongata, and spinal cord. Dieckerhoff found an œstrus larva in the cervical portion of the spinal cord in a horse.

The reports of psychic paraplegia or nervous apoplexy of the spinal cord seem completely inexplicable. Failure to discover diseased conditions on post-mortem examination of animals dead of paraplegia in no way proves that such have not existed, and this is especially true of paraplegia due to concussion of the spinal cord. Aruch describes three cases of psychic paralysis in dogs following punishment. Hagen saw paraplegia in an old horse after fright by a locomotive. The condition disappeared in three days. Probably

other unexplained causes were at work in these cases. Complete paraplegia has been seen in horses after powerful electric shocks produced by lightning. Paraplegia and general severe nervous depression follow shocks by high-tension electric currents (500 volts). Cadiot recently published an interesting report on the subject. (See *Jour. Comp. Path.*, and *The Veterinarian*, March, 1903.)

Paraplegia may also follow changes in the nerves, vessels, or muscles of the hind limbs. As these will afterwards be considered separately it is only necessary here to mention lesions of the lumbosacral plexus and thrombosis of the aorta.

Since olden times every permanent disturbance of function in the hind limbs has been described as incomplete chronic paraplegia. As a rule such disturbances are accompanied by peculiar irregularities in movement and rolling gait, but these symptoms cannot be viewed as characteristic of any one disease; they may be caused in various ways. Without doubt change in the spinal cord plays a chief part, but unfortunately in paralysis thorough post-mortem examinations have not been made. The difficulty in movement and the course of the disease point to chronic morbid processes in the spinal cord. In horses, there is usually a difficulty in co-ordinating movement termed ataxia, similar to that in *tabes dorsalis* in man. The separate groups of muscles do not act together; harmony of function is wanting.

The conditions, however, to which these symptoms are due cannot be brought about, as Dieckerhoff believes, by over-extension of the fasciæ. In *Dourine*, which is followed by progressive paralysis of the hind-quarters, changes have been found in the spinal cord. Hæmorrhagic myelitis with formation of cavities in the spinal cord (syringomyelitis) and degenerative processes were met with at isolated points. In other varieties of paraplegia changes could doubtless be found in the spinal cord, provided examinations were made in advanced stages and by proper methods. Wolff saw the hind-legs trailed in horses in consequence of fracture of the caudal vertebræ; here the change had clearly extended to the spinal cord from the point of fracture. On the other hand, it must be allowed that incomplete paraplegia is not always the result of primary disease of the cord, nor even of changes produced in it by infection as in *influenza* or *strangles*; it may also follow disease of the vertebræ. In France, paraplegia is generally considered to result from injury to the spinal column in the dorsal or lumbar region, and is described, therefore, as vertebral displacement (*entorse dorso-lombaire*). Vatel

has given a thorough description of the post-mortem of a horse affected with this disease. According to Peuch and Toussaint, the inter-vertebral discs in the dorsal or lumbar region sometimes appear yellowish-green and partly destroyed; in advanced stages they quite disappear, granulations form on the bodies of the affected vertebræ, become fused and so lead to the formation of a synostosis. Sometimes exostoses form in the vertebral canal and press on the spinal cord. These changes may be associated with rupture of the muscles. Rigot states having found hæmorrhages in the *psoas* muscles, and Goubaux abscesses in the *longus colli*. In these cases it certainly seems that the condition has been confused with other diseases.

In horses, a condition simulating incomplete paralysis often occurs from exposure to cold, but disappears after a short time. In such cases muscular rheumatism is probably the cause.

Intermittent paralysis of the hind-limbs, owing to obstruction of the blood-vessels of the thigh and pelvis, is not uncommon. Tumours may also develop in the vertebral canal or extend into it, compressing the cord and causing paraplegia. In a horse brought to the Alfort clinique, carcinomata were found pressing on the spinal cord and causing paralysis. Secondary carcinomata existed in the abdomen. Kampmann saw paraplegia in a foal from perforation of the second lumbar vertebra by a cyst which had discharged its contents into the vertebral canal.

In cows, a condition which occurs during the last period of pregnancy, but generally disappears after parturition, has been described as incomplete paraplegia (*ante-partum* paralysis). It is really due to insufficient muscular power to raise the greatly increased body load, and is favoured by advanced age, defective nutrition, very fat condition, or continuous confinement to the stable. In these animals, lesions in the spinal column and pelvis (fissures) resulting from parturition occasionally cause complete or incomplete paraplegia. Whether so-called "reflex paralysis" occurs seems doubtful. A great number of bovine diseases described as paraplegia are clearly due to mistaken diagnosis of painful conditions in the hind-legs and digits.

In sheep, paraplegia sometimes results from the presence in the brain of *cœnurus cerebralis*, a parasite, which has also been seen in the ox. In the later stages of sturdy, sheep always suffer from creeping paralysis of the hind-quarters and irregular movements of the hind limbs.

In dogs, paraplegia is sometimes caused by injury (concussion)

of the spinal cord or fracture of vertebræ, but more often results from distemper and depends on chronic disease of the brain or spinal cord. Siedamgrotzky found œdema of the cord, Johnes yellow points of softening in it; and acute or chronic myelitis and atrophy of the cord have also been detected. In three dogs and one rabbit Mauri noted paralysis and rolling movements; red softening of the cerebellum was discovered on post-mortem.

Complete and incomplete paraplegia have also been seen in swine. Complete paraplegia is commonest in sucking-pigs on account of the little animals being trodden on by the mother; in older swine rickets may produce it. Paraplegia has also been seen in birds; Siedamgrotzky noted it in parrots. Its cause is little understood.

Symptoms and course. It is clear that conditions differing so much in their anatomical causation are not likely to agree in their symptoms. Nor do the clinical appearances usually exhibit such well-marked peculiarities as to admit of definite anatomical diagnosis. The nature of these conditions has already been determined to some extent in man, but in animals it still remains obscure. Researches are specially needed in incomplete paralysis; exact diagnosis of the causative condition in complete paralysis of the hind-quarters is less interesting on account of the animals being killed as incurable, or dying in consequence of decubitus (a complication which can seldom be prevented), though exceptions occur even here, as, for example, in *commotio medullæ spinalis*, and the course of the disease must, therefore, be carefully watched. The sudden appearance of symptoms, however, does not necessarily indicate acute disease; an army horse which had suddenly shown paralysis of the hind-quarters was found to be suffering from an osteo-sarcoma of the spinal column.

Complete paralysis of the hind-quarters is distinguished:—

(1) By inability to stand. The animals lie and are unable to rise without assistance. In exceptional cases, the function of the crural nerves, and therefore the ability to stand, is preserved, though the animal is unable to walk. This may be due to the fact that the lesion of the spinal cord is behind the exit of the nerve referred to (fourth to sixth lumbar vertebræ). The same peculiarity also occurs in fracture of the spinal column in the dorsal region, as has been noted in horses. Dogs sometimes learn to walk on the fore-legs, as related by Nocard; they lift the hind-quarters into the air by powerfully contracting the *longissimus dorsi*, &c., after the manner of circus dogs.

(2) Reflex irritability is completely in abeyance, and the animals make no resistance to the operator's manipulations. This is always the case where the seat of disease is in or behind the lumbar portion of the cord. When in front of this spot, that is, in the dorsal region or further forward, reflex irritability is not only retained, but may often be abnormally pronounced (hyperæsthesia), so that stimulation of the skin, ligaments, or bones (slight blows, or pricks with a needle) cause active contractions in the paralysed muscles. Continuous contraction (cramp) may thus be caused (spastic paralysis). Nocard saw increase of the tendon reflexes in a dog.

(3) In grave lesions of the cord, sensibility appears to be completely lost; in myelitis spinalis it is at first not much impaired; its continuance points to injury of the posterior columns and of the grey posterior cornua. In pressure paralysis, sensibility may sometimes be increased, as shown by Nocard's reported cases in dogs; movement of the paralysed hind-quarter produced acute pain (paraplegia dolorosa). The examination of large animals is more difficult, because sensation cannot be exactly gauged, reflex movements being so difficult to distinguish from those caused by painful sensations.

(4) To the above cardinal symptoms of paraplegia are added those of paralysis of the bladder, rectum, and tail. There is often incontinence of urine, and fæces cannot be discharged without assistance. This grouping of symptoms generally accompanies pressure paralysis from fractures of vertebræ or of the sacrum, from extravasation of blood into the vertebral canal, and in rarer instances from tumours, but may also occur in concussion of the spinal cord. The diagnosis must be based on the history of the case, its manner of origin and course. In fractures of the vertebræ, displacement of fragments or crepitation may be detected.

The symptoms of **incomplete paralysis** show still greater variety; but even though it is not possible, in every case, to form an accurate diagnosis, it is well, from the clinical standpoint, to distinguish two kinds:—

(1) Paraplegia incompleta vera, vel spinalis (true incomplete or spinal paralysis); and

(2) Par. incompleta spuria (incomplete spurious paraplegia). The causes of the first lie within, those of the second without the vertebral canal. Paraplegia of the first kind, due to acute or chronic inflammation of the spinal cord and its membranes, or to pressure and degenerative processes in the medulla spinalis, declares itself by the following symptoms:—

1. Disturbance in movement, distinguished :—

(a) By loss of strength, and

(b) By irregularity in movement. The animals show weakness, and rapidly become tired ; the hind limbs, though able to sustain the weight of the body, only slightly assist in forward progress, and, during walking, make irregular ataxic movements.

Ataxia is a form of interference with movement arising from defective co-ordination. The proper innervation of the separate groups of muscles is interfered with, in consequence of which their contractions are not harmoniously combined. Single groups contract too much or too little, others too early or too late.

In horses and dogs, such symptoms accompany incomplete paraplegia. The hind-feet are lifted hesitatingly and incompletely from the ground ; the toe may be dragged and gradually worn, or the heels may first come in contact with the ground, the toe being tilted at each step. In the next stage the foot is lifted suddenly and to an abnormal height, is set down awkwardly and with a tapping movement, and often describes a semicircle outwardly ; the feet are placed crosswise over one another, while the hind-quarters roll first to one side and then to the other (plaiting the legs). These ataxic movements are particularly well seen when turning ; the animal has difficulty in backing.

2. Sensibility and reflex irritability are generally retained, the latter may even be increased, causing exaggeration of the tendon reflexes. In general the same remarks apply here as were made in reference to complete paraplegia.

3. Muscular atrophy. This is seldom seen in incomplete spinal paralysis, or is confined to gradual atrophy of both sides in consequence of inactivity. In one case Cadéac found the pectoral, scapular, humeral, femoral and facial muscles soft, yellowish, atrophied and degenerated.

4. The paraplegia of dogs, due to disease of the spinal column, is almost always associated with spastic contraction of the extensors, and, according to Dexler, with anæsthesia of the testicle.

The exceptional occurrence of atrophy in the spinal form of incomplete paraplegia shows that the cause lies in front of the trophic centre of the muscles, that is, in the posterior columns of the medulla, as paralysis due to brain injury generally takes the form of hemiplegia.

The several causes of paraplegia incompleta spuria lie outside the spinal cord or spinal column. They sometimes consist in fissuring

of vertebræ, disease of the inter-vertebral discs, or still more frequently muscular disease, which may be of a rheumatic character, due to chill, or of purely mechanical origin. In the horse the latter is more frequent, because in it violent, intrinsic, or extrinsic, over-extension of muscle produced during heavy and unwonted exertion is common. When animals are continuously overworked, permanent interference with muscular function in time results, causing the mechanical efficiency of the muscle to become impaired. The resulting disturbance has been referred to disease of the fasciæ, but the truth of this statement has never been satisfactorily established. In this form muscular atrophy is well marked.

Voller describes a form of paraplegia which suddenly developed in a mare after parturition, simultaneously with deformity of the spinal column between the 14th and 15th dorsal vertebræ. The animal could stand, but could only walk with difficulty; it made rolling movements with the hind-quarters. At first, movement was greatly interfered with, but afterwards improved, though the spinal deformity continued. Johow saw a fifteen-year-old horse which had suffered from weakness of the hind-quarters for a period of six months. The difficulty was greatest in the morning on getting up and making the first few steps. One day complete paraplegia suddenly set in. The body of the first lumbar vertebra was found, on post-mortem, to be one-third thicker than that of the others. The thickening encroached on the vertebral canal and pressed on the spinal cord, which had correspondingly diminished in thickness.

Harms found the connection between the anterior ends of the glutei maximi and the longissimus dorsi torn away on both sides in a four-year-old horse. When resting, nothing remarkable could be seen, but during movement the hind-quarters rolled from side to side. A large cavity could be seen on either side of the spinal column, at the point where the large gluteus arises from the longissimus dorsi. In front of the ilium an elevation was noticeable. After movement, the anterior end of the large gluteus returned to its normal position, as could easily be seen. No improvement occurred.

Prognosis in complete paraplegia is unfavourable, and only those cases due to concussion of the cord have any chance of recovery. In large animals the prognosis is much less favourable than in small ones, the former always dying at an early stage from decubital necrosis and horses even sooner than cattle.

In incomplete paraplegia, the prognosis naturally depends principally on the nature of the causative process. Recent and sudden cases, especially those resulting from accident, offer more hope of recovery than the more chronic, which are generally due to some incurable disease. The condition usually becomes gradually worse, though at times it seems to remain nearly stationary, and allows animals to be used for considerable periods at a walking pace.

Treatment. In paralysis, the animal must have a suitable soft

bed and if unable to rise be frequently turned over to prevent decubitus. Easily digested food is indicated. The bladder and rectum must be emptied from time to time, and sometimes purgatives are desirable. Further treatment must depend on the nature of the cause; rest and cold applications are indicated in superficial mechanical injuries; hot moist packs or applications of hot sand or bran in rheumatism; at the same time the muscles may be rubbed with stimulant lotions, &c.

In incomplete paralysis, treatment must be based on a knowledge of the original cause; when this is mechanical, the animal should be placed in slings. Rheumatic conditions are to be treated as above. When inflammation of the spinal cord or its membranes is suspected, irritants like mustard poultices or cantharides can be employed. To combat atrophy of the muscles, gentle exercise should, as far as possible, be given, and the parts massaged by kneading or striking (tapotement). In horses good results sometimes follow subcutaneous injection of veratrin, or gradually increasing doses of strychnine.

In dogs, the continuous or induced electric current may be employed. The induced current can scarcely be used in horses, on account of their great sensitiveness to it and the resistance they offer.

In dogs, Zwicker recommends injecting 7 to 10 minims of a solution prepared as follows: Eserin, .6; pilocarpin, 1.2; water, 80. He gives carbonate of potash solution in syrup internally.

Mouroit claims to have cured paraplegia in a horse in three weeks by subcutaneous injections of testicular extract from a goat. After removing its envelopes the testicle was rubbed into a paste with water, and a quantity subcutaneously injected each day. Until confirmed by further successes such reports should be received with caution.

IX.—DISEASES OF THE TAIL.

(1) PUTTING on one side operative wounds, injuries of the tail are most frequent in dogs and oxen. In the former they are caused by blows and treads, by the tail being struck against the walls of the kennel or other objects, or by its being run over. Defective sensibility seems to play a certain rôle here. Paræsthesia, that is, abnormal subjective sensibility, sometimes causes dogs to gnaw the point of the tail, exposing the vertebræ; Prietsch saw this in a lion. Pruritus of the tail in horses may be due to worms in the rectum, to acari infesting the tail, or to eczema.

In cows, bruises are produced by blows from sticks, by violently

bending the tail to make the animal move, or by squeezing it between two sticks, which is done for the same object. At one time the root of the tail was often injured by operations intended to eradicate disease. Such injuries were sometimes inflicted on swine for the purpose of bleeding. In oxen, pleuro-pneumonia inoculation sometimes produces severe inflammation in the tail, especially if septic material is employed. Sometimes the tail whilst soiled with dung is accidentally wounded, or it may be bruised in a cattle truck. Injuries of this kind in oxen, when not promptly treated, are readily followed by infective cellular inflammation, or ulceration, which may extend to the vertebræ producing a chronic disease which was formerly viewed as specific. Necrosis, resulting from cellulitis, may set in and cause sloughing of portions of the tail. The outer skin being closely applied to the caudal vertebræ, severe swelling at the root of the tail is liable to be followed by necrosis, the pressure exercised by the greatly distended skin impeding circulation. In the horse sometimes the tail is excoriated and partially depilated from incessant rubbing, the itching arising from irritation caused by psoroptes or eczema.

Symptoms and course. Injuries to the tail are easily detected. Cellulitis is marked by diffuse swelling, which often extends to the body causing fever, and other symptoms of constitutional disturbance and even death. In other cases the inflammatory swelling leads to partial necrosis of the tail and sometimes sloughing of the vertebræ.

Cancer of the tail has been seen in the horse. Cadiot and Dollar describe a case ("Clinical Veterinary Medicine and Surgery"). Two growths as large as walnuts, and with firm, reddish, excoriated surfaces, appeared on the lower surface of the tail about 4 inches from its base. There were other smaller growths. Removal and cauterisation produced temporary improvement, but the growths recurred, and the horse was eventually slaughtered. On post-mortem examination the tissues in the pelvic region, as well as the spleen, liver, and lungs, were found to be invaded by the new growth.

In dogs, the point of the tail is often raw from continually striking against neighbouring objects; it may be covered with a dry scab or with fluid discharge. The animal may lick or even gnaw the parts continually, exposing the last two or three caudal vertebræ. The condition is commonest in short-haired and large dogs. Recovery may follow proper treatment, but frequently amputation of the extremity of the tail is necessary, and even this may fail to stop the process, for the animals gnaw the exposed stump, and the difficulty

arises *de novo*. In a lion, Prietsch twice amputated portions of the tail before healing ensued.

Treatment. Preventive treatment consists in cleanliness; where the parts are already infected antiseptics should be adopted.

To check cellulitis it may be necessary to scarify the skin of the tail lengthwise, and to follow this by the application of an antiseptic surgical dressing. Block scarifies as deeply as the periosteum, and rubs in common salt or turpentine.

In dogs it is best to smear the wound with iodoform, collodion, or tar, or to cover it with a dressing and leather sheath to prevent the animal licking and gnawing the point of the tail. Should this fail, the part must be amputated. Sometimes cauterising the stump will be found useful. Horses are occasionally seen with so-called "Rat-tail" or loss of the long hairs of the tail. Up to the present the exact cause of this affection is unknown, though it has been attributed to psoroptic invasion; nor is there any sure means of preventing the loss of hair, or of assisting its return. Perhaps the best treatment consists in periodic thorough washing and the use of sulphur iodide ointment. Popow recommends scarification of the skin of the tail, but its efficacy requires further confirmation. Pruritus can be lessened or arrested by frequently washing the tail with carbolic lotion.

(2) Paralysis of the muscles of the tail. Difficulty in moving the tail may be caused by fractures of the sacrum or caudal vertebræ, and by inflammation and new growths, but primary nerve disease of the caudal muscles also occurs in horses and dogs, both as an accompaniment of paraplegia and independently of it. The disease is oftenest seen in mares, though it sometimes attacks geldings. It generally commences slowly; at first the tail is not carried in the ordinary way, but hangs more or less limply, swinging to and fro as the animal moves, and becoming soiled by urine and fæces. After the lapse of several months, paralysis of the bladder (incontinentia urinæ) with fæcal retention occurs, and manual assistance becomes necessary to empty the rectum, the last portion of which is gradually dilated. If relief be not afforded, the animal suffers from colic. There is marked anæsthesia of the base of the tail, perineum, vulva and rectum. Finally, paraplegia incompleta appears, with atrophy of the muscles of the quarter and of the hind-leg.

In 1890, Dollar saw several cases as sequelæ to influenza. In one the symptoms were preceded by exudation of lymph into the posterior chambers of the eyes and the animal became temporarily blind. All of the cases seen had finally to be slaughtered.

Dexler found the following appearance on the post-mortem examination of a case: The sacral portion of the muscles of the tail showed marked fatty degeneration, and the muscular bundles were of a pale yellow colour. The muscles of the tail proper were pale, transparent and cedematous. The rectum was greatly dilated. The mucous membrane of the bladder was swollen, yellowish-red in colour, and uneven. From the last lumbar

vertebra onwards the epidural fat rapidly diminished in quantity and finally disappeared; from the first sacral vertebra to its termination the spinal canal was filled with a greyish-white, firm growth of such dimensions that it could scarcely be extracted, except in fragments. Microscopically, this growth consisted of connective tissue, partly interposed between the nerve bundles and partly surrounding the nerve stems. The calibre of the vessels was greatly diminished in consequence of thickening of the tunica intima. The nerve elements had undergone partial fatty degeneration. The spinal ganglia in the lumbar and sacral regions showed marked increase of the interstitial material and complete degeneration of the nerve elements. The condition, therefore, consisted in an inflammation of the cauda equina.

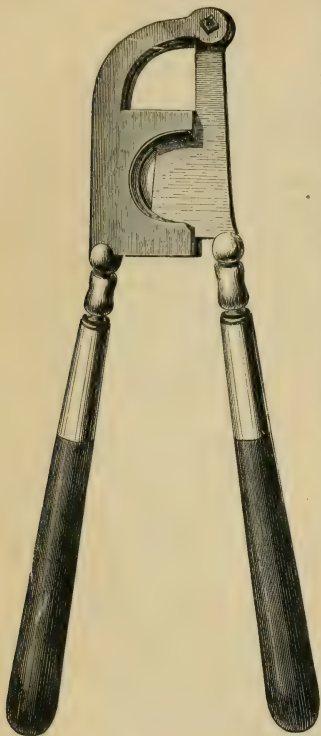


FIG. 451.

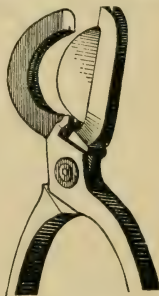


FIG. 452.

The process secondarily affected the nerve trunks and spinal ganglia and led to degeneration of the muscular groups served by them.

Prognosis is unfavourable, as treatment has hitherto proved powerless against this gradually progressive disease. In most cases stimulants, tonics, and even electricity will be found useless. Röder gave strychnine without success. The animal gradually becomes worse, finally unworkable, and has to be killed. A mare seen by Deigendesch died from rupture of the bladder.

(3) Tumours of the tail occur in horses, oxen, and dogs. Fibromata, carcinomata, botryomycomata and sarcomata, and in old grey

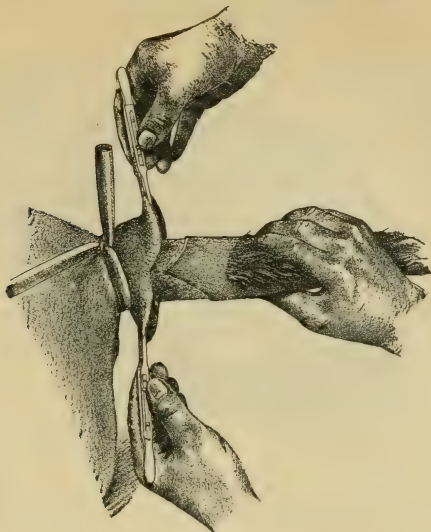


FIG. 453.

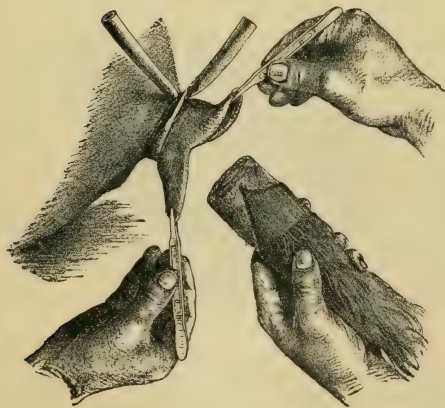


FIG. 454.

horses melanomata, are not uncommon. Lehnhardt and Rosenbaum have seen vascular new growths on the tails of oxen. These

sometimes start from the skin, sometimes from the vertebræ of the tail, and produce ulceration, or they extend to the perineal connective tissue, and lead to obstruction of the bowel.

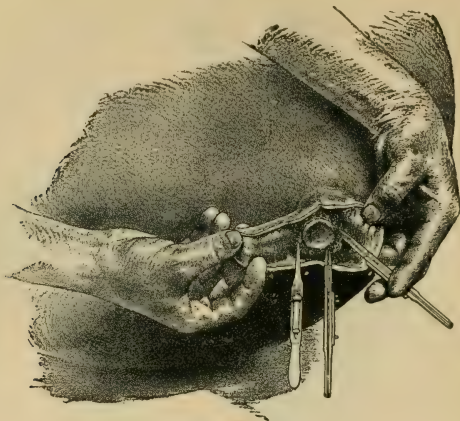


FIG. 455.

Diagnosis is easy, but it is otherwise with treatment. Superficial tumours, that is, those having their seat in the skin, may easily be

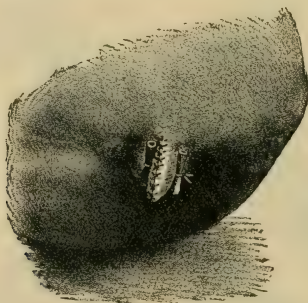


FIG. 456.

removed with the knife, but if they rise from the vertebræ amputation of the tail is the sole resource. Caudal botryomycosis when occurring at the end of the tail may be successfully arrested by amputation; but when the disease attacks the base, though operation may be attempted, treatment by local applications of

iodine and administration of potassium iodide is generally preferable. Tumours near the end of the tail are dealt with by docking; those near the base are, however, more serious, and necessitate amputation, a double-flap operation being that generally employed.

Bayer proceeds as follows: After shaving and disinfecting the skin, a rubber cord is tightly applied round the base of the tail. Two flaps are then formed by semi-elliptical incisions of suitable length so as to ensure sufficient skin being left to cover the stump without tension. The tail is then divided close to the base of the flaps, by disarticulating one of the caudal joints. The rubber cord is then cautiously relaxed, any bleeding vessels are picked up and ligatured, the wound is thoroughly cleansed, and the two flaps are carefully brought into contact. When the initial incisions have been skilfully made, the flaps will cover the stump without difficulty, and without being either tightly stretched or inclosing too large a cavity. It is best to form the flaps rather longer than absolutely necessary in the first instance, as they can afterwards be easily reduced with scissors or the knife. The edges are then brought into exact contact with closely inserted silk sutures, and should any cavity remain a couple of "tension sutures" are used to obliterate it. The several stages of the operation are well shown in the foregoing illustrations (Figs. 453 to 456).

X.—NECROSIS OF THE LUMBO-DORSAL FASCIA.

THE lumbo-dorsal fascia (fascia lumbo-dorsalis) lies beneath the panniculus in the region of the back, and covers the dorsal extensors like a sheath. Its superficial portion arises from the outer angle of the ilium, becomes attached to the superior spinous processes of the lumbar and dorsal vertebræ and to the ligamentum nuchæ, and continued downward in the fasciæ of the abdominal muscles, and forward to the scapular fascia. Its deep portion is confined to the lumbar region. It connects the transverse processes of the lumbar vertebræ to one another and to the outer angle of the ilium. The dorsal fascia gives attachment to various muscles, and forms the medium of connection between the extensors of the back and the muscles of the hind-quarter. It is best developed in horses.

Suppuration in the skin of the back following external injury with infection, sometimes results in necrosis of the dorsal fascia. Sooner or later large tracts are destroyed. Möller has repeatedly seen this in horses; cases last for weeks, and give the greatest difficulty in treatment. Recovery is quickest after surgical removal of the diseased portion; pus formation is checked by continuous

irrigation with disinfectants. Schmidt saw a foal in which the fascia was the seat of purulent necrosis extending from the withers to the pelvis. On incision, necrotic pieces of tissue and offensive pus were discharged. Although the ribs could be felt on introducing the finger, recovery occurred in six weeks by using carbolic lotion, but few cases prove so rapidly amenable to treatment.

DISEASES OF THE FORE LIMB.

A. DISEASES OF THE SHOULDER REGION.

I.—FRACTURES OF THE SCAPULA.

ON account of the position and slight mobility of the scapula in domesticated animals, it is comparatively seldom broken, though fractures are described as having resulted from blows with blunt bodies, from collisions, kicks, treads, and falls, particularly from falls on the shoulder, or with the legs widely straddled. Trasbot saw the scapula fractured by struggling whilst in hobbles; oxen occasionally fracture the bone in falling. The accident is also at times caused by violently reining-up animals, the neck of the bone being then generally broken.

Sometimes the cervical or dorsal angle is broken across, sometimes the spine or body, not infrequently the neck or glenoid cavity. The greater number of these fractures are subcutaneous; only occasionally is the skin perforated. Such fractures are commonly fissured, but comminuted fractures also occur. Complications are commonest after fractures of the spine, the fragments of bone becoming necrotic and causing abscess formation. Möller saw one in a horse which was working in a gravel-pit during the winter. The scapula was crushed into more than eighty pieces by the falling of a mass of frozen earth.

Diagnosis. In well-nourished animals, notably in horses, and in cases where severe swelling has occurred, diagnosis is difficult. Displacement of the broken fragments is often slight, and crepitation may be entirely absent. It is, therefore, clear that every marked, rapidly-produced lameness, which is evident both when the animal stands on the limb and when it moves, must awaken suspicion of fracture of the scapula, provided there is no other self-evident cause.

Fracture of the scapular spine is the only one of the above conditions in which the foot may be placed on the ground in the usual way, though movement is then in the highest degree painful. In fracture of the scapular spine, and of the anterior or posterior angle of the scapula, the fragments can be displaced with the hand. Fractures of the neck of the scapula are attended with excessive mobility of the limb, especially in ab- and ad-duction. Fractures

of the body are most difficult to diagnose, but may always be surmised if crepitation be present whilst the humerus is known to be intact.

Course and prognosis. The nearer the fracture is to the lower end of the bone the graver the condition. This principle, established by Binz, must be borne in mind ; it rests on the fact that, in fractures of the upper portion of the scapula, the fragments are not so easily displaced, and the pain is less.

The prognosis of fracture through the glenoid cavity is most unfavourable in working animals, and especially in horses. Anchylosis almost always follows, and in consequence the animal is permanently lame. Fracture near the neck of the scapula does not necessarily prevent the animal again becoming useful, especially if the fragments are not much displaced ; sometimes perfect usefulness is restored. This is oftener the case in fractures of the body, and almost always so in fractures of the spine and upper portions of the scapula, provided they remain subcutaneous. Compound fractures are always dangerous, because of infection extending beneath the fascia of this region, though compound fractures implicating only the spine often heal if sufficient time be given for the separation and discharge of the fragments. The less the pain and lameness the greater the chance of healing ; but when, in horses and cattle, such symptoms are marked, it is better to slaughter the animals unless they are of particular value for stud purposes, as they suffer severe loss of condition during recovery. Marked pain forces the animal to rest entirely on the other foot, and there is then danger of laminitis and descent of the fetlock, especially if the patient stands continually. Increased pulsation in the metacarpal artery, and attempts to rest the foot, point to this complication, which is so painful that the animal generally lies down and cannot be moved. Death may then occur from decubitus.

In small animals, particularly in carnivora, subcutaneous fractures of the scapula generally unite in four to six weeks, but lameness sometimes remains. In a few cases necrosis of the entire scapula has been seen after fracture. (Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery.")

Treatment. Displaced portions must, as far as possible, be replaced, which is easiest with the patient in the prone position and under chloroform. In large animals, however, the operation is always difficult, and even when successful does not ensure that the fragments will remain in position. The bandaging and plasters so often recommended are of little use except in small animals. When pain is not sufficient to compel the animal to keep the lame limb at rest,

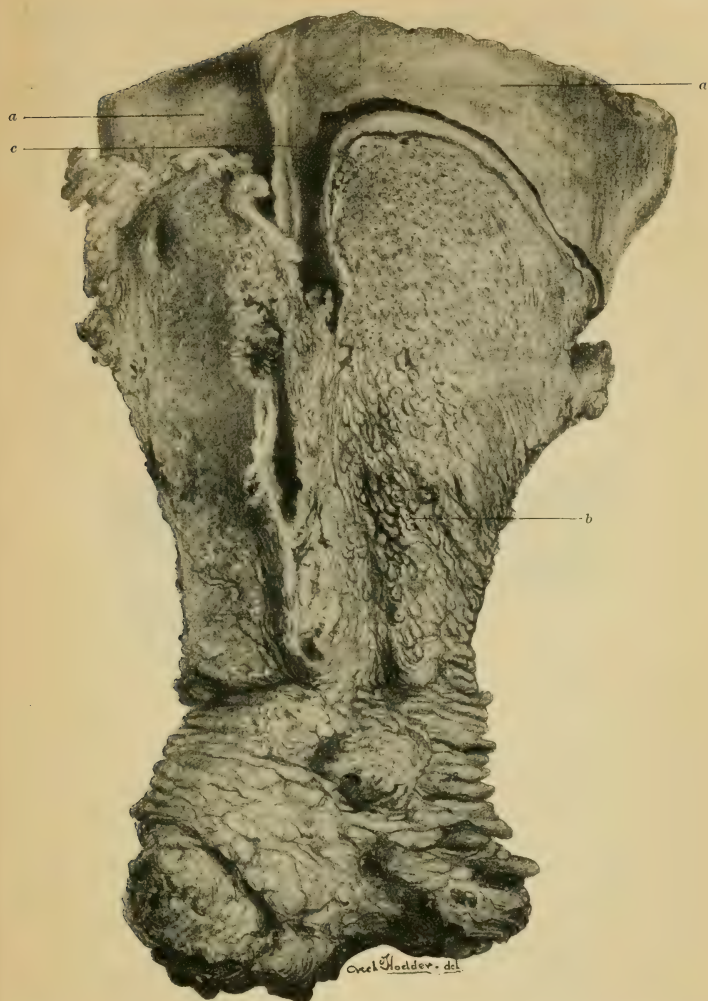


FIG. 457.—Total necrosis of the scapula. *a*, Sequestrum; *b*, case of bone formed by the periosteum; *c*, space filled with pus in fresh specimen. (Hodder's case.)

and especially when weight cannot be borne on it, early slaughter is preferable to treatment, with its doubtful results. Animals which

lie down should have a thick straw bed, otherwise they may be placed in slings, and kept as quiet as possible. If in compound fractures treatment be resolved on, attention should first be directed to rendering the wound aseptic, and to keep it so; a dressing is indispensable.

In small animals suitable bandages are more easily applied. They should include the thorax and lower part of the neck, so as to ensure their remaining in position.

II.—FRACTURES OF THE HUMERUS.

THOUGH fractures of the humerus are as a whole uncommon in animals, they nevertheless occur with some frequency in dogs, in which one or other condyle breaks away from the lower end of the humerus. Peuch and others have seen double-sided fracture of the humerus in horses. Fracture occasionally follows muscular exertion,

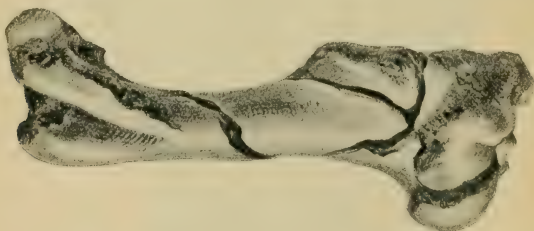


FIG. 458.—Fracture of the humerus. (Hodder's case.)

as in rearing, or even in trotting. Horses at grass may be kicked on the arm. Comminuted fracture may occur without accident, while the horse is trotting at a moderate pace over paved streets, and horses returning from the forge after shoeing and without falling may sustain fracture of both humeri. Drosse saw fracture of the "outer and upper protuberance of the humerus" (ridge), and removed the piece of bone; recovery occurred in fourteen days. Six or seven weeks later the animal stumbled and broke the humerus in the direction of its length.

Fractures of the diaphysis of the humerus are commonest in cattle and dogs, and are produced by external violence, kicks, collisions, treads, or accidental falls; occasionally in horses by the animals being suddenly wheeled round whilst being ridden. The figure shows the humerus of a horse which ran away and came in collision with a wall,

Fractures of the condyles are caused by treads, notably in dogs, though similar cases have been seen in horses. Sometimes the external, sometimes the internal condyle is broken off in consequence of the supporting leg making a violent rotary movement, or the free leg being excessively ad- or ab- ducted. In dogs such fractures are produced by awkwardly jumping or falling from a chair or table. Of twenty-six fractures of the humerus in dogs treated by Stockfleth, seven were through the diaphysis and nineteen through the condyles.

As a rule, **diagnosis** of fracture of the diaphysis offers no difficulty. There is severe pain both when the animal stands on the limb and when it moves; swelling and abnormal mobility and crepitation when the scapula is fixed; the other bones of the limb are found intact. In such cases there can be no doubt. It is more difficult to detect fracture of the condyle. Sometimes the disconnected condyle is movable, and there may be crepitation; diagnosis is easiest in the dog. On account of the anatomical construction of the elbow-joint in dogs, the external condyle when broken off is usually drawn upwards, whilst the internal becomes visible on the inner side of the elbow-joint, and appears lower in position than usual. This increased prominence of the internal condyle seems to have given rise to a belief that in the dog it (the internal condyle) is the more frequently fractured. In horses there is severe lameness when the limb is carried, and inability to place weight on the foot. The leg is adducted (turned in) in fracture of the extensor condyle, and abducted (turned out) in that of the flexor. In the former case the lower joints of the limb are excessively flexed, so that the front of the hoof is in contact with the ground, owing to the relaxed extensor muscles being loosened from their upper points of insertion. During recovery, this abnormal position of the limb often suddenly disappears, and if, in fracture of the flexor condyle, weight be then placed on the foot, the knee is excessively extended, so that the anterior surface of the limb appears concave; this is particularly noticeable during trotting, at the moment when weight is placed on the foot. When accompanying abnormal flexion of the elbow-joint, this symptom is explained by the relaxation of the flexor metacarpi, consequent on loosening of its upper point of insertion. The same is true of the flexor tendons in fractures of the inner condyle. Otherwise this symptom only occurs in rupture of the flexors, or in fractures of the pisiform bone, and is, therefore, of particular diagnostic value. It does not occur in carnivora.

Fissuring of the humerus, or fracture of the outer wall of the shaft with depression of the broken part, can scarcely be diagnosed owing

to the thick muscular covering of the bone, though it may be suspected.

Course. In carnivora, fractures of the condyles almost always unite in six to eight weeks, though some interference with movement of the elbow may remain. Stockfleth and Möller in dogs have seen such fractures occur in both legs simultaneously, and yet reunite. Möller's case was in a sporting dog, which afterwards regained its usefulness. Opinion should, however, be guarded, as the condyle sometimes fails to heal, and in old dogs, even when this occurs, movement of the elbow-joint is often very limited on account of callus formation. In another case, in a horse, recovery took between two and three months, and yet the animal was finally quite able to work. Williams appears to have had less favourable results, for he declares that union of the broken condyle seldom occurs, and that in consequence lameness is permanent.

Fracture of the diaphysis is less hopeful in all classes of animals, especially in draught-horses, and as a rule, no good comes of attempting treatment. It is otherwise with valuable breeding-horses, particularly if of quiet temperament, and in the smaller domestic animals healing is quite possible so long as displacement is not great, and the other foot is able to bear weight. Under these circumstances recoveries have been noted. Warnecke saw fracture of the humerus in a stallion, and Meredith compound longitudinal fracture in a horse, reunite in ten weeks. Numerous fragments of bone were removed and an antiseptic dressing applied. Numbers of similar cases have been reported. Vogt relates a case where in a cow the broken shaft of the humerus united. A serious point for consideration is whether the marked shortening of the limb, which always occurs in impacted fracture, may not make the horse or ox useless. **Prognosis** is more hopeful in small animals, especially when the fragments are not much displaced. Not only is reduction easier, but in carnivora the humerus may be supported with bandages, particularly if the fracture is near the lower end.

Treatment. In horses and cattle suitable bandaging can scarcely be effected, and recovery must, therefore, be left to nature. The complicated dressings recommended in France do not seem to assist much in retaining the fragments in position.

Calves and young cattle sometimes make remarkable recoveries when left untreated in a loosebox or shed. In carnivora, on the other hand, the lower portion of the humerus may be bandaged, and in them it is also possible completely to fix the broken condyle. A plaster bandage is applied extending from the metacarpus as high

as possible, and care taken that the elbow-joint is moderately flexed, so as to avoid a bad position afterwards. The lower part of the limb should neither be fixed in a position of excessive supination nor of pronation. In three to four weeks the animals commence to place weight on the foot, and the bandage may then be removed. At first the elbow-joint cannot be freely moved, but the amplitude of movement gradually increases, especially if passive exercise be given. In one case Frick attempted to fix the displaced condyle in position with bone sutures, but the bone proved too friable and the sutures tore out. Such operations, however, are perfectly practicable provided careful antisepsis be observed; the fragment may be fixed in position with wire sutures, or, as in human practice, with ordinary wood screws which have been silvered.

Large animals, and notably horses, require slinging. After prolonged slinging, however, the animal may show signs of acute laminitis in the foot on which it stands. Despite the risk of displacement, there is then no other course open but to allow the animal to lie down, trusting that union may be sufficiently far advanced to prevent bad consequences. The bed must be soft and the box roomy. If the animal refuses to lie down, there is little hope of recovery.

III.—DISEASES OF THE SHOULDER-JOINT.

THE shoulder-joint, which in all domesticated animals is a ball-and-socket joint, possesses a lax capsular ligament. The reinforcement of the capsule in front by strong connective tissue and the protection afforded by muscles, limit movement in the joint, and only allow moderate abduction, adduction, and rotation, though considerable flexion and extension. Flexion of the shoulder-joint is limited by the biceps, extension by the caput muscles, abduction by the subscapularis, adduction by the antea and postea spinati, so that the shoulder-joint in domesticated animals possesses far less mobility than in man. The oval, nearly flat glenoid cavity is much smaller than the head of the humerus. In swine and carnivora, the size of the former is increased by a cartilaginous margin. In these animals the shoulder-joint is also connected with the bursa intertubercularis.

(a) Luxation of the Shoulder-Joint.—Complete displacement is much rarer than in man, though it occurs both in horses, ruminants, and dogs. In swine and carnivora, the position of the caput humeri is ensured by the cartilaginous extension of the glenoid cavity; in the horse, by the tendinous biceps muscle.

Luxation can generally be referred to excessive flexion of the joint, and the humerus is, therefore, always thrust forwards and

upwards, the head of the bone being discovered in front of and above the glenoid cavity of the scapula. As the biceps muscle antagonises this movement, displacement can only occur when that muscle is partially relaxed, as it would be, for instance, during simultaneous flexion of the elbow-joint. For this reason luxation of the shoulder-joint results most frequently from falls in jumping. A sudden check to the movement of the lower portions of the leg may also bring it about. Hertwig saw several such displacements, on account of the feet striking against some obstruction in leaping. Excessive movements of abduction may also result in the head of the humerus being displaced inwardly beyond the glenoid cavity of the scapula.

Symptoms. The accident is distinguished by excessive lameness, which appears suddenly, and is most marked when the leg is being moved. Passive movement of the joint is also interfered with. Whilst there is much difficulty in flexing, and still more in extending, the joint, abduction and adduction are abnormally easy, and the leg appears shortened. Provided swelling be not excessive, dislocation of the head of the bone can be discovered by palpation. Pressure on the parts produces pain. Complications, like fracture of the scapula or humerus, often coexist.

Prognosis and course. The results of many observations seem to indicate that even complete luxation, if early reduced, can be cured in two to three weeks. Smith, after reducing a supposed dislocation under chloroform, caused the horse to be moved, and it then showed no distinct lameness; eight days later it was nearly sound. The diagnosis, however, in this case is not beyond question. In other cases reduction, even under anæsthesia, being impossible, chronic lameness remains. In working-horses, it is best to wait for eight to fourteen days after reduction, and if in this time no improvement is manifest, the animal should be slaughtered. Reduction being easier in small animals, the prognosis is correspondingly more favourable.

Treatment. In large animals, which stand quietly, attempts may be made to reduce the dislocation without casting. Siedamgrotzky advises that one man should hold the animal's head, another draw the leg forward, and a third press on the knee-joint to extend it, whilst the operator endeavours to return the head of the humerus to the joint cavity by strong pressure. Should this fail, the animal must be cautiously cast and the attempt repeated. To produce muscular relaxation anæsthesia is necessary, but if fracture of the glenoid portion of the scapula coexist with luxation, the humerus will not remain in proper position. A noose is passed round the

leg, and two or three powerful men effect extension by pulling on it. Counter-extension is provided by a girth passed round the animal's body. The operator stands on the joint and supervises the direction of extension, whilst endeavouring to replace the head of the bone. Successful reduction is notified by the production of a loud click and by restoration of free movement to the limb. Failing reduction by this method, the elbow-joint is strongly flexed, and fresh attempts made; if the head of the humerus lies in front of the glenoid cavity, this way is more likely to be successful. The shoulder muscles retain the parts in position, so that bandaging is not usually necessary. Lodezzano, however, in the case of a cow, cut away the hair from the shoulder, smeared the parts with a mixture of pitch, turpentine, and wax, and applied a stiff piece of cloth; when the mass became hard, fresh layers were applied. In pronounced inflammation, cold applications are indicated. Absolute rest is necessary, and should be continued as long as any trace of lameness exists. To prevent recurrence, which is liable to follow attempts to rise, the patient should be placed in slings for a few weeks. Blistering also diminishes free movement of the shoulder and tends to prevent recurrence. Bourgelat employed an iron splint like a horse-collar to assist retention. The apparatus is generally unnecessary, unless the animal be allowed to lie down.

(b) Contusions and Distortions of the Shoulder-Joint.—These accidents are in general rare. The absence of firm ligamentous structures tends to prevent distortion occurring, while the muscles of the shoulder, especially the biceps, shield the joint from contusion. As long as the limb remains in its normal relationship to the trunk, even the violent concussion resulting from falls is not injurious. On the other hand, both excessive abduction, adduction, and rotation, produced by slips, falls, or attempts to free the foot which has become fixed in some obstruction, may result in distortion of the joint. The many lamenesses described under this head consist, however, in injuries to the biceps and to the bursa intertubercularis.

Symptoms. Inflammatory disease of the shoulder-joint is recognised by sudden lameness when lifting the leg, by the limb being abducted, and by the animal being unwilling to place weight on the foot. The forward stride is shortened, the movement of the limb is slow, the backward movement impaired, so that the hoof is dragged along the ground. Inflammatory swelling, accompanied by increased warmth and pain, appears about the shoulder. **Diagnosis** is often doubtful, and the disease then falls under the category of shoulder lameness (see "Shoulder Lameness").

Prognosis and course. The degree and extent of the injuries associated with distortion being very varied prognosis is equally uncertain. It must, therefore be principally guided by the degree of lameness and the character of the local symptoms, as well as by the time during which these have existed. If pain is slight, complete recovery may occur in three to four weeks; gradual improvement during this time points to a favourable issue. On the other hand, chronic arthritis may sometimes cause lasting and incurable lameness. The more severe the lameness, and the longer it has existed, the less favourable the prognosis; marked atrophy of the shoulder muscles is, therefore, an exceedingly grave symptom.

Treatment. Complete rest must always be the first measure. Cold applications, irrigation, or poulticing combat inflammation. At a later stage irritants, blisters, and setons can be employed. The subcutaneous injection of atropine and morphine has been recommended by some but condemned by others. It might be worth trying.

(c) Wounding and Inflammation of the Shoulder-joint (Omarthritis).—On account of its position, the shoulder-joint is seldom wounded. Romant describes a torn wound of the joint in a mule, in which perfect recovery followed the employment of sublimate solutions. As a general rule, these injuries call for cautious prognosis and treatment.

Spontaneous inflammation of the shoulder-joint is seen in oxen and dogs under the form of rheumatic arthritis; in foals, calves, and lambs, as a complication of so-called navel-ill. The shoulder-joint is, however, not particularly prone to this disease. The knee and hock are much more frequently attacked. Abscesses in the neighbourhood of the joint seldom break into its cavity.

Chronic omarthritis may either be a sequel of distortion and luxation, or be of rheumatic origin. Williams gives two illustrations of chronic omarthritis in horses, showing the edge of the joint covered with oxostoses; the synovial membrane was thickened, and to some extent ossified; in one case synostosis had occurred.

Prognosis. The variations in the pathological conditions are so great that no fixed principles can be laid down either for prognosis or treatment. The degree of local change, the severity of the lameness and the time it has existed, form the chief indications. Excessive muscular atrophy and obstinate lameness are always grave. The symptoms are equally varied (compare with "Shoulder Lameness").

IV.—INFLAMMATION OF THE BURSA OF THE BICEPS, FLEXOR BRACHII OR CORACO RADIALIS MUSCLE (BURSITIS INTERTUBERCULARIS).

DURING flexion and extension of the shoulder-joint the tendon of the flexor brachii glides over the bicipital groove of the humerus, which is covered with fibro-cartilage, and forms one of the boundaries of an extensive bursa (bursa intertubercularis). The bursa extends from the periphery of the cartilage-covered tuberosities, over the tendon, clothes a portion of its surface, then its sides, and finally its under face. The sides of the bursa are covered by the lower points of insertion of the supraspinatus muscle, and its cavity is divided from the capsule of the shoulder-joint by a mass of fat. In swine and carnivora, the bursa is continuous with the shoulder-joint. Its position is nearer the central line of the body than in the horse.

In horses, the extensive intertubercular bursa is sometimes the seat of acute or chronic inflammation, in which the biceps tendon shares, and which almost always results from severe bruises, such as are caused by collisions when the shoulder is struck and the biceps receives the full shock. Wounding of the bursa may be followed by acute septic inflammation. Runaway horses frequently suffer.

A chronic bursitis (which may be bilateral) is produced in tramway and omnibus horses by half-falls, or slipping in rapid driving.

As in acute inflammation of other synovial bursæ, serous and fibrinous exudates occur; in infected wounds and metastatic diseases purulent inflammation of the bursa of the tendon may set in. Dieterichs saw symptoms of acute inflammation, hyperæmia, and exudation in horses which had shortly before fallen ill. Necrosis of the bursa in the horse was seen by Möller. The tendon was partially necrotic, the gliding surface on the humerus deprived of fibro-cartilage and eroded.

Chronic bursitis produces abrasion of cartilage, formation of exostoses on the humerus, and ossification of the biceps. Williams and Dieterichs found the muscle almost entirely ossified, though in Dieterichs's case the biceps had become adherent to the humerus. The gliding surface of the biceps is frequently roughened from friction against the altered bicipital groove. Villate has also seen ossification of the muscle, with abrasion of its gliding surface.

Symptoms. Acute bursitis intertubercularis is shown by excessive lameness when the leg is advanced (swinging leg lameness). On attempting to move the animal, the foot is not carried forward, but remains at a point behind that of the other side, giving the impression that the foot cannot be lifted from the ground. When forced to move, the horse places absolutely no weight on the lame leg (Fig. 459). It moves back without much difficulty, and may then be able to

lift the foot a little. Even after pain diminishes, the foot still remains behind when moving, and the forward stride appears much shortened. During rest, the foot is placed behind its neighbour, and weight may even be borne on it, a symptom seen by Brauell and K. Günther even after cutting through the biceps. Inflammatory symptoms (increased warmth, swelling, and pain) sometimes appear in the

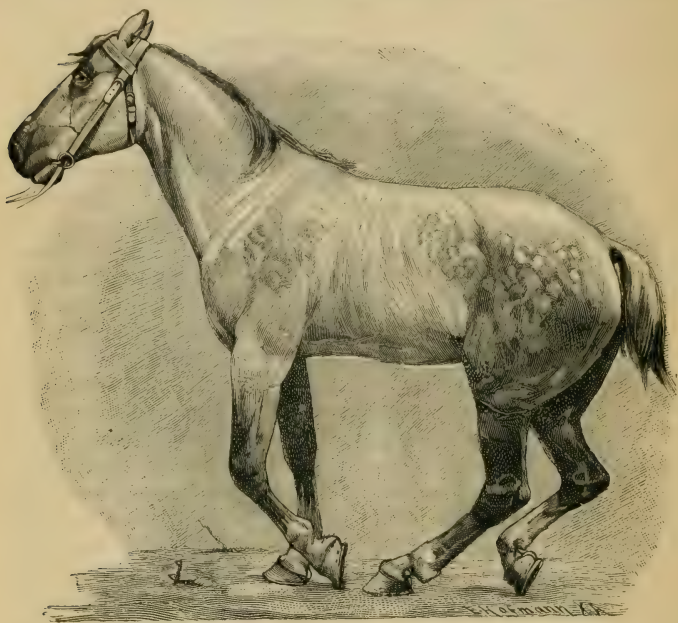


FIG. 459.—Lameness from bursitis intertubercularis (the horse is being led).

muscle and neighbouring parts, though they seldom bear any direct relation to the degree of lameness.

In chronic bursitis intertubercularis, well marked symptoms are wanting, though there is inability to place weight on the leg, and the forward stride is shortened. When the disease appears bilaterally, the animal seems “tied at the shoulder.” In some cases both atrophy and shortening of the muscles occur.

Prognosis and course. Acute bursitis occasionally takes a favourable course, but is prone to become chronic. When severe, the animal may be inclined to lie continuously in one position,

otherwise recovery occupies several months, and chronic lameness is apt to remain ; treatment is, therefore, only advisable in valuable horses. If the local symptoms are slight, if weight is still placed on the foot, and if lameness is not severe, recovery may be looked for in six to eight weeks, but sometimes takes several months.

In chronic bursitis, prognosis is even less favourable, though the disease takes a slower course, and the animals continue to some extent useful.

Treatment must follow general principles, being guided by the existing changes. In acute bursitis, it comprises absolute rest, cold applications (best in the form of ice poultices), or permanent irrigation with cold water ; as the pain diminishes, warm moist applications, at a later stage counter irritants (blisters and firing) should be tried.

Dieterichs says that in horses lameness is sometimes caused by dislocation of the biceps muscle. Such a case never occurred in Möller's practice, nor did Hertwig, even in his extensive practice of so many years, see one. Dieterichs's description leaves it doubtful whether the condition occurs, and the same may be said of Becker and Dominic's cases. From the latter's statement, it is clear that the scapula was displaced, but probably from muscular rupture.

Rupture of both biceps muscles was seen in a fourteen-year-old gelding which had suddenly gone lame. The region of the shoulder-joint was swollen and painful. The condition somewhat improved, and the horse was put to light work ; but four months later, after being driven about two miles, became suddenly much worse, and appeared to have lost control of both fore-limbs. It was placed in slings, but gradually wasted, whilst the thorax sank between the shoulders, so that four weeks after the last attack the withers were $4\frac{1}{2}$ inches lower than before. The sternum reached to the lower half of the fore-arm, and the scapula lay in an almost horizontal position. Both shoulder-joints were greatly swollen, but not painful. The animal's movement was passable, though it often stumbled. Post-mortem showed extensive periostitis around the shoulder-joint. Instead of the coracoid process, there only existed on the scapula a roughened spot, the biceps muscles of both sides were torn away from their scapular insertions, and their tendons thickened (Nesbit).

V.—INFLAMMATION OF THE TENDON OF THE POSTEA-SPINATUS MUSCLE AND OF ITS BURSA.

ON the external tuberosity of the humerus above the point of insertion of the outer tendon of the postea-spinatus muscle, is a bursa, which, with the tendon, sometimes becomes inflamed. K. Günther first drew attention to this affection, and showed that it may be caused by bruises, kicks, collisions, falls, or by strain of the tendon. When horses with narrow chests and closely-placed fore-legs are used for fast-trotting work this tendon may become

strained on account of increased abduction of the shoulder necessitated by the special conformation.

Symptoms. The disease produces lameness during the period when weight is placed on the limb (supporting leg lameness) and abduction of the entire limb. Weight is certainly put on the foot, but the latter is placed outwards, by which abduction of the shoulder, and consequently painful extension of the diseased tendon, is as far as possible avoided. There is pain on pressure over the affected spot, together with increased warmth and swelling. Crepitation may sometimes be detected by applying the hand (tendovaginitis crepitans).

Prognosis and course. The nature of the disease renders a rest of at least four to eight weeks absolutely necessary, but recovery always occurs if the patient is given sufficient time.

Treatment. Acute inflammatory processes are combated by cold applications, later moist warm applications can be used, or, if necessary, irritants, or the actual cautery.

VI.—PARALYSIS OF THE SUPRASCAPULAR NERVE.

THIS lameness was first observed in 1785 by Rohlwes. In 1864 Bouley suggested that it was due to rupture of the tendinous insertion of the postea-spinatus muscle. It was first correctly diagnosed and described by K. Günther; of late years it has been repeatedly seen in horses. Frick saw a case in an ox resulting from the animal being frightened and springing forward into the manger; lameness was at once apparent.

The suprascapular nerve, an important branch of the brachial plexus, passes between the supraspinatus and subscapularis muscles and turns round the coracoid border of the scapula to gain the dorsal surface where it furnishes branches to the supraspinatus and infraspinatus muscles.

The cause of paralysis of the suprascapular nerve is violent backward movement of the shoulder or of the leg whereby the nerve is overstretched. The general causes are running against trees, against the manger or other firm objects, or against another horse, as in cavalry attacks. It is therefore common in cavalry horses, in runaways, or in animals which have been struck by the carriage pole. Cadiot has seen it follow casting for operation; the horse had been kept down for a long time. At the end of two months wasting of the postea-spinatus was very marked. Reported cases seem to indicate that it sometimes accompanies hæmoglobinuria and rheumatism. Hansen saw a case produced by a door slamming and striking the

animal. The causes are therefore similar to those of bursitis intertubercularis. The difference consists in this, that violence to the unloaded limb thrusts it back, and is apt to cause this paralysis, whereas violence to the limb when supporting the body causes contusion of the shoulder, backward movement being then impossible. This paralysis is therefore more likely to be produced when the shoulder is struck by a heavy, slow-moving body than where the blow is given suddenly; in the latter case the biceps and its bursa are endangered.

The symptoms are explained by the loss of function in the scapular muscles which extend the shoulder-joint. Whilst nothing abnormal can be remarked as long as the limb is rested, sudden abduction occurs immediately weight is placed on it, and at the moment when the foot is perpendicularly below the body. The scapula and humerus are then jerked away from the wall of the thorax. This movement is best seen when the horse is slowly walked in a straight line.

The disease then is distinguished by lameness when weight is placed on the limb (supporting leg lameness), by abduction of the limb, and by jerking of the shoulder outwards at the moment when the leg is perpendicular. Atrophy of the paralysed muscles occurs later, and is most marked in the supraspinatus and infraspinatus, whilst the deltoid, which receives its innervation from the circumflex nerve, remains intact. The atrophy is rendered more noticeable by the projection of the spine of the scapula.

Roloff saw a horse which had suddenly exhibited double-sided shoulder lameness during heavy work, and found marked atrophy of the extensor muscles. The shoulder-joint was thrust outwards. In this case probably there was double-sided paralysis of the suprascapular nerve. In cattle, on the other hand, a somewhat similar condition is caused by over-extension or relaxation of the adductor group (subscapularis and teres major). It is seen in particular races, such as the Holsteiners, especially in winter; in summer, when the animals are pastured, it often disappears.

Prognosis and course. Paralysis caused by mechanical injuries is known to be less favourable than the rheumatic forms, and treatment is often unsuccessful. As a general rule, prognosis is much less favourable than in paralysis of the radial nerve, though recovery sometimes occurs in six to eight weeks. Otherwise, and especially if the lameness continue severe—that is, if the difficulty in movement has not begun to disappear—there is little hope. Of five cases seen at the Berlin school, three alone recovered, though Kattner effected a cure in six weeks. Of ten cases of suprascapular lameness seen between 1875 and 1890, three were discharged improved and four

uncured. The case in a bull before mentioned remained uncured. Marked atrophy of the paralysed muscle is an unfavourable symptom, though one case mentioned by Lesbre recovered completely and the atrophied muscle was restored after an interval of eighteen months. The return of irritability under the faradic current is a reliable sign of improvement. While animals affected with this lameness cannot be employed in rapid draught, yet they can still do slow work in a breast-collar; the ordinary collar tends to displace the shoulder.

Treatment must follow general principles. Little can be done to check the progress of already-existing pathological changes in the nerve. At first the patient must be rested, and attempts made to increase local nutrition, and thus prevent atrophy, by kneading or tapping the muscles for 15 or 20 minutes twice daily. Massage may possibly favour removal of already-existing changes in the nerve; for the same purpose veratrin may from time to time be injected. One and a half grains of veratrin (the variety insoluble in water) is rubbed down with about 75 minims of water without adding alcohol, and the mixture injected beneath the skin over the region of the muscle. Good results have been seen from subcutaneous injection of oil of turpentine.

On account of the excessive sensitiveness of the horse, the use of electricity, especially of the induced current, is generally too troublesome to be of service, though it is one of the most effective means of arresting loss of muscular and nervous irritability, and may perhaps be tried in valuable animals. When similar symptoms follow bruising, cold applications are preferable.

Of three horses with this lameness sent to the Berlin school in rapid succession, two showed traces of violence in the shoulder region: one had run away and struck the affected shoulder against a tree, the other one had also been in collision. Symptoms of lameness appeared shortly after the accidents. One of the three horses soon became sound; the two others appeared incurable. Later two more cases were seen to recover, one in spite of the fact that there had been considerable rupture of muscle.

Williams describes, under the name of "shoulder-slip," a disease said to occur in plough-horses, which are obliged to walk with one foot at a lower level than the other. According to Williams's description, this appears to be paralysis of the suprascapular nerve, though he describes pathological changes in the spinati and teres muscles, as well as in the shoulder-joint. He especially mentions abrasion of the bursa of the postea-spinatus muscle, and rupture of its tendon. It can be proved that rupture of this tendon, which

sometimes occurs after inflammation of its sheath, produces the same disturbance in movement as paralysis. Section of the tendon of the postea-spinatus results in precisely similar lameness. Dewar has pointed out that the foregoing description of paralysis of the suprascapular nerve is exactly applicable to the condition known to horsemen in Scotland as "slipped shoulder," the most common form of which is atrophy of the subspinatus muscle in three-year-old horses being trained to agricultural work. The muscles of both sides are often affected. As these animals work in traces, and have not to back, the cause in their case can scarcely be a backward movement of the shoulder.

The disease may, of course, be accidentally complicated with other injuries. Thus, in a riding-horse which had run away and struck its shoulder against a tree, the levator humeri and pectoralis transversus were ruptured and there was paralysis of the suprascapular nerve. Rupture had probably occurred in other of the breast muscles. Soon after the injury the hair fell away from a particular patch of the skin and severe eczema developed. The longish oval patch, which began about a hand's-breadth below the shoulder-joint, extended perpendicularly upwards almost to the middle of the neck. At the centre, and just over the shoulder-joint, it was about 8 inches broad, and became smaller both in an upward and downward direction. The hair which afterwards grew on the patch was of a lighter colour, and if the animal was excited or slightly pushed sweating occurred here, whilst all the rest of the body remained dry. The patch was also insensitive to the prick of a needle. Without doubt this was a case of simultaneous paralysis of the superficial scapular nerve. The condition improved, but very slowly.

VII.—PARALYSIS OF THE RADIAL NERVE (PARALYSIS NERVI RADIALIS).

THE radial (or musculo-spiral) nerve derives its fibres mainly from the dorsal roots of the brachial plexus, but it also receives fibres from the 7th and 8th cervical branches, and passes downwards and backwards on the subscapularis and teres major muscles, and some little distance behind the axillary vessels, from which it is separated by the ulnar nerve. On reaching the deep humeral artery, it disappears in front of the large head of the triceps, and is continued round the humerus in the musculo-spiral groove, where it rests on the brachialis anticus, and afterwards, on the posterior or outer border of that muscle. Before the nerve disappears behind the humerus, it gives branches to the great and small heads of the triceps and a long branch which passes backward to divide under the scapulo-ulnaris for the supply of that muscle. Behind the limb it supplies the median

head of the triceps and the anconeus, and furnishes a few cutaneous branches, which perforate the caput medium. In the fore-arm the nerve supplies the extensor muscles of the knee, fetlock and pastern, and the flexor metacarpi externus.

Paralysis of this nerve used often to be seen, though not accurately diagnosed. Harms states having recognised this paralysis in a cow. In 1875 Möller saw the disease repeatedly in horses, and then for the first time carefully described it; it has since been frequently diagnosed. During the last few years Möller has often seen this lameness in horses, and in one case in the dog.

Even at the present time little is known of the causes of radial paralysis. Sometimes it appears in horses which have been cast for a long time, especially if lying on sand or on the earth. But it is doubtful whether such lameness is not principally myopathic and produced by continued pressure on the triceps muscle, interfering with circulation; its rapid disappearance supports this view, which seems in accord with similar observations in man. Fröhner has asserted that the condition in question is a myopathic paralysis of the caput muscles, and supports his contention by the results of examination of the muscles in two slaughtered horses suffering from the disease. These changes, however, were probably secondary in character. Lanzillotti-Buonsanti, who found similar lesions, pointed out that they were strictly confined to muscles served by the radial nerve. Moreover, the nerve itself was hyperæmic. There can be little doubt that in cases of long duration the nerve, and not the muscles, is the structure primarily affected. Lustig saw radial paralysis lasting thirty-eight days after a tedious dental operation. Since casting on soft mattresses has become common, such cases have seldom occurred.

As a rule, radial paralysis occurs suddenly during harness work, clearly pointing to a traumatic origin, though in many cases there is no history of an accident of any sort, and as a rule there is no mark of injury. During a very short period in the summer of 1887 Möller saw many horses with this disease, which is generally rare. It therefore seemed as though a specific cause were at work, a view confirmed by the peculiar clonic spasms of the triceps muscle seen in other horses. These spasms ceased during work, but returned with rest, and could be produced by flicking the muscles with the finger. Bormann in horses twice diagnosed radial paralysis which set in in the same sudden fashion. One case seen by Werner, and described as paralysis of the extensor pedis, occurred after violent attempts to free the foot, which had been caught in some obstruction. Bräuer

saw this lameness result from long exposure to rain during work, Lübke also saw double-sided partial radial paralysis caused by chill ; the disease was accompanied by fever, and proved fatal.

In the year 1890 Möller saw a case of diplegia of the radial nerve in the horse. The disease suddenly appeared in the left limb during a journey, and, being painful, caused the animal to lie a great deal, following which the radial nerve of the right limb became affected. Friis describes a case complicated with paralysis of the hind-leg of the opposite side (*hemiplegia cruciata*).

A series of interesting clinical records and a full description of this disease will be found in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery."

Willis, Rogers, Hunting and others have drawn attention to the frequency with which pronounced radial paralysis is associated with fracture of the first rib. For a time, indeed, it was believed that radial paralysis was always caused by fracture of the first rib, but careful research has disposed of this view. Rogers in 1894 described the following case in an eight-year-old well-bred chestnut mare. The animal had been worked for three hours in a victoria, and returned home with great difficulty, exceedingly lame in the off fore-leg. The near fore-heel showed signs of a recent overreach. The animal was in great pain, and supported the weight of the body mainly on the hind-legs ; the off fore-leg was flexed, the knee and fetlock bent, and the outside of the toe just touched the ground. The elbow was lower than normal, but was not excessively "dropped." By forcing the knee backwards, and thus straightening the leg, the animal was enabled to take one step with the sound limb ; but immediately the knee of the injured limb became in the least degree bent the leg collapsed, and the animal nearly fell. Progress was facilitated by pulling forward the lame leg as far as possible, and then pressing on the knee until a step had been taken with the sound leg. The most marked symptoms were absolute inability to advance the leg, and great difficulty in keeping it perpendicular. No fracture of any of the leg bones could be distinguished. Crepitus was entirely absent. Fractured first rib was diagnosed, and the animal was placed in slings.



FIG. 460.

During the three weeks and three days it was kept, the limb was always flexed and turned slightly inwards, so that the outside toe of the foot became worn.

Post-mortem examination showed fractured first rib (see Fig. 460); the surrounding muscles were not lacerated or ruptured. Only a small provisional callus had formed. The broken and overlapped pieces of bone were freely movable, and not (as might appear from inspection of the figure) rigidly fixed together.

The reason why fractured first rib and marked radial paralysis

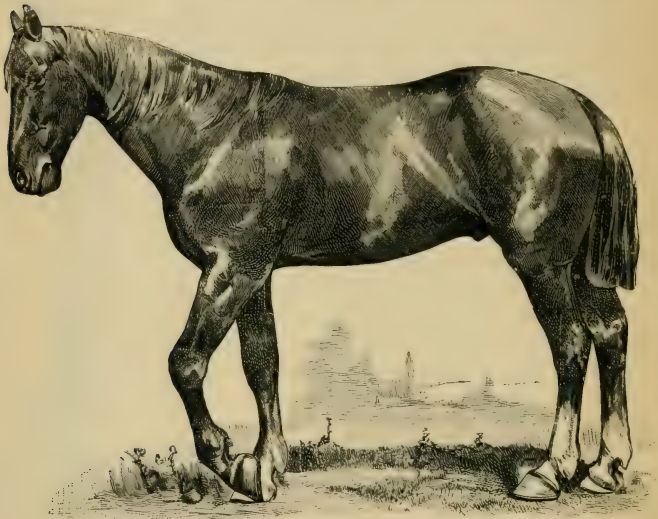


FIG. 461.—Complete paralysis of the radial nerve.

are so often associated is to be found in the proximity of the brachial plexus, from which the radial nerve originates, to the site of fracture. Even in incomplete fracture a sufficient effusion of blood may occur to interfere seriously with the nerves of this plexus.

The symptoms vary according to the degree and extent of the paralysis. When complete, the limb takes a position resembling that in very painful affections of the foot. The shoulder and elbow are extended, while all the other joints are fixed in a position of volar flexion, those of the phalanges often to such a degree that the anterior surface of the wall of the foot may be almost in contact with the ground (Fig. 461), the limb under such circumstances appearing to

be too long. In attempting to move, the upper portions of the limb are carried forward in the ordinary fashion, but cannot support the weight of the body on account of inability to bring the joints into the necessary position. The limb collapses at every attempt to place weight on it.

The disease is, therefore, characterised by lameness when weight is placed on the limb (supporting leg lameness), flexion of all joints from the elbow downwards, and inability to bring the foot sufficiently forward to enable it to carry weight; when passively extended, however, the limb is able to sustain the body. On moving the horse

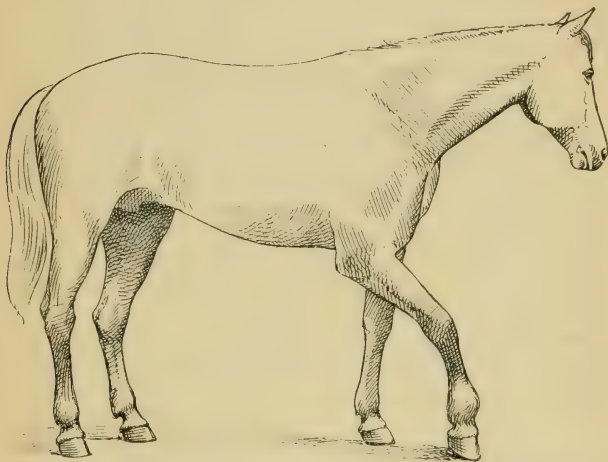


FIG. 462.—First portion of the stride in a case of paralysis of the radial nerve.
The animal was recovering.

the triceps muscles appear relaxed. They fail to contract, and after some time atrophy.

In incomplete radial paralysis the weight of the body can be supported provided sufficient muscular power exist to extend the joint. When, therefore, the animal moves slowly, and on a smooth surface, nothing particular is visible, though lameness appears immediately the horse meets with a slight incline or with any obstacle. In such case the foot is not sufficiently extended, it strikes against the obstacle and the leg collapses, so that the horse may fall. Depending on the degree to which nerve or muscle is affected, this stumbling occurs more or less frequently; sometimes it is only seen

after exertion on soft or uneven ground. When the lameness diminishes after having long existed, the animals instinctively adopt a peculiar way of moving. In stepping out they slide the foot forwards with exaggerated action of the shoulder muscles, so as to compensate for the defect in the extensors of the elbow. The lameness is characterised by stumbling, particularly on uneven ground, and later by a sliding motion of the foot when the limb is extended.

Cases of radial paralysis due to fractured first rib can sometimes be diagnosed by drawing the affected limb towards the opposite side of the body, and sharply returning it to its former position. By applying the ear over the scapula while this manipulation is performed by an assistant crepitation may be detected.

Not infrequently paralysis is partial. The greater number of cases seen by Möller in the summer of 1887, and certain cases observed later, were distinguished by the fact that the function of the caput medium and of the extensors lying in the region of the fore-arm was clearly retained, whilst the other portions of the caput muscle appeared relaxed; when weight was placed on the foot these contracted in the usual way. For this reason the lameness has a peculiar character: during the period when weight is placed on it, and at the moment when the limb is perpendicular, the shoulder is suddenly jerked forwards, causing the disease to present a certain similarity to suprascapular lameness. But as these involuntary movements take place in a forward direction (best seen by moving the horse slowly and viewing it from the side), the disease is readily distinguished from the above lameness, where the shoulder moves directly outwards.

The reason of the caput medium being sometimes unaffected in this lameness must be sought in the distribution of the nerves. From the point of origin twigs are first given off to the head of the caput magnum muscle; these are comparatively short fibres, whilst the main stem distributed to the caput medium and parvum and extensors of the foot lying in the fore-arm region is much longer, and is, therefore, not involved to the same extent in any strain occurring here. The correctness of this view is supported both by the fact that partial paralysis occurs accidentally after mechanical injuries, and that in such cases function is always retained in the extensors of the knee, of the fetlock, and of the foot.

As already stated, paralysis in these groups of muscles can be detected during movement both by sight and feeling. Muscular atrophy occurs sooner or later, and to an extent varying according to the amount of functional disturbance. Sometimes, though no

invariably, sensation is lost in the skin covering the anterior and external surface of the fore-arm.

Differential diagnosis. The disease may be mistaken for myopathic lameness of the caput group of muscles, or for any of those conditions in which they partially or completely fail to act. This is particularly true of oblique fracture of the ulna—the lower point of insertion of these muscles—and of rupture of the extensor pedis. Hertel saw all the extensors attached to the ulna torn away, but in such cases local examination at once dispels any doubt.

Diagnosis and course. The twenty cases of radial paralysis seen by Möller all eventually recovered, though not with equal rapidity; incomplete paralysis usually disappears in fourteen days, but the greater number of cases of complete paralysis last for five to six weeks or longer. Certain severe cases, possibly due to fractured first rib, require six to nine months for complete recovery. Three cases relapsed after some weeks' severe work, but finally did well. **Prognosis** is therefore, generally favourable. Uncertainty of movement sometimes remains even after disappearance of lameness, but disappears in time. The longer lameness continues, the less the chance of cure. Well-marked muscular atrophy is therefore unpropitious, but return of irritability to the Faradic current must be regarded as a favourable sign.

Treatment. In the greater number of Möller's cases no particular treatment was required. Electricity is only worth trying in valuable horses, but massage, especially in complete paralysis, is certainly of the greatest value in assisting nutrition of the muscles. When paralysis is incomplete, daily exercise on soft ground and at a slow pace is for the same reason advisable. If thought desirable, subcutaneous injections of veratrin and strychnine may be employed. The application of powerful douches can only be regarded as a kind of massage. Bormann effected recovery in five to six weeks by giving strychn. nitr. $\cdot 3$ to $\cdot 6$ grain subcutaneously; but in this time the disease would generally disappear without any treatment whatever.

A less frequent variety of intermittent radial paralysis has been seen by Möller. A young carriage-horse, which showed nothing unusual in the stable, or when beginning work, displayed symptoms of radial paralysis in the right fore-leg as soon as it had gone about two miles. The condition was first incomplete, as shown by stumbling, but gradually became complete, with the above-described characteristic symptoms. By resting the animal, the symptoms disappeared in about half an hour, to reappear, however, as soon as work was

resumed. Möller suspected thrombosis, but although the post-mortem was conducted with the greatest care, nothing could be detected, so the cause of this rare disturbance remained unexplained. There was no muscular atrophy.

VIII.—PARALYSIS OF THE BRACHIAL PLEXUS.

PARALYSIS of the brachial plexus usually arises from some local cause. Compression of the plexus between the shoulder and the trunk may happen in operations where the horse is kept lying for a long time in one position as with a fore-foot fixed to a hind-limb. Holmann saw paralysis of the entire muscles of the fore-limb in a horse following on a fall and found on post-mortem severe bleeding around the brachial plexus. From his description it is, however, clear that simultaneous rupture of the serratus magnus existed, for the horse was not only unable to move the foot, but the body sank several inches at each attempt to place weight on the limb. The limb was also abnormally abducted.

Trasbot describes a case of paralysis of the brachial plexus in which hemiplegia appeared later. Recovery occurred in fifteen days. This case is also not quite clear. Wilson saw hemiplegia in a horse after rolling over backwards, and Anacker has seen it in a sucking-pig.

In dogs it is commoner, and occurs both as peripheral paralysis and as hemiplegia. In the latter condition Möller repeatedly saw well-marked spastic lameness in all the muscles of the shoulder, most notably in the triceps group; this was followed by long-continued disturbance in movement.

Paralysis of the brachial plexus in horses is sometimes of central origin; in these cases other troubles precede, accompany, or follow it. A seven-year-old mare showed in December, 1887, right-sided facial paralysis; in January, 1888, left-sided hemiplegia. The toe of the left fore-foot was dragged along the ground. Soon afterwards a small cataract appeared in the right eye, and gradually involved the entire lens. The post-mortem showed a tumour as large as a walnut between the petrous portion of the right temporal bone and the cerebellum; it extended to the pons varolii and restiform bodies of the medulla. Its interior was occupied by a small quantity of pus.

Shocks from the high-pressure currents used to operate street trams or railways may produce brachial paralysis, which, however, passes away, provided the shock has only been momentary.

Lightning stroke produced paralysis of the brachial plexus in a Prussian army horse, but the condition disappeared again in a few days.

Another case occurred in the Alfort clinique. A horse was cast and kept down for a long time. On rising it showed complete paralysis of one fore limb. Post-mortem examination showed that the brachial plexus had been bruised and paralysed by a bony tumour on the second rib.

Many cases of brachial paralysis are produced in this way, resulting from bruising, subscapular bleeding, deep-seated abscess formation, the growth of tumours on the inner surface of the shoulder, or even from direct injury like that due to the deep penetration of a carriage shaft.

The symptoms which accompany paralysis of the brachial plexus depend on whether paralysis is complete. Complete paralysis of the entire axillary plexus prevents all voluntary movement in the limb. Provided, however, the foot be placed in the proper position the limb, at least in the horse and dog, is still able to support weight, but again collapses when the weight is removed. The body load is better sustained so long as the radial nerve remains unaffected, but there is difficulty in advancing the foot. When contraction occurs in the triceps muscles, the leg, from the elbow downwards, is continuously fixed in extreme extension. This position is retained even during movement.

Prognosis and course. The prognosis must be based on general principles, as our knowledge of this lameness is still very incomplete. As would be expected from its cerebral origin, spastic paralysis of the brachial plexus in dogs is generally incurable.

Treatment is similar to that of radial lameness. Massage, which improves nutrition and prevents atrophy of muscle, is of more use than drugs.

IX.—SHOULDER LAMENESS.

BESIDES those above described, other lesions occur in the shoulder region, some of which evade even the most careful examination, and cannot be exactly diagnosed, or their results foretold. Lameness is the sole symptom, and for want of clearer knowledge these conditions have been included under the general term "shoulder lameness." As the chief muscles for the movement of the limb are found in the shoulder region, it is not surprising that these lamenesses show a certain agreement in symptoms. They are almost always marked by lameness when the limb is carried, *i.e.*, movement

appears chiefly or solely interfered with during the forward stride, and the affected limb is advanced slowly and incompletely. The lameness varies according to the position, nature, and extent of the disease process; and therefore under each condition these points will be more fully noticed.

(1) Disease of the shoulder-joint and its surroundings. As a rule, this consists in chronic inflammation, which cannot be directly recognized by clinical means. Arthritis chronica, with erosion of cartilage and periarticular exostoses, is met with in old horses. In cattle and dogs rheumatic disease of the shoulder-joint occurs, and often produces lameness. Sometimes passive movements of the shoulder, raising and lowering the foot, occasion pain, and by relaxing the muscles of the shoulder make the head of the humerus more prominent. Atrophy follows long-continued lameness. As a rule, there is pain when weight is placed on the limb, and especially when the animal is turned in short circles.

In a horse which had suffered from chronic shoulder lameness, Siedamgrotzky found great thickening of the anterior surface of the joint, and chronic inflammation of the bursa intertubercularis. The synovial membrane was thickened and covered with numerous thread-like proliferations, and the articular surface of the scapula increased to the extent of about an inch by a circular bony growth. The cartilage covering the articular surfaces of the scapula and humerus was abraded.

(2) Disease of the muscular tissues of the shoulder is sometimes traumatic, sometimes rheumatic, in origin. External violence, or violent falls or leaps, may produce inflammation of the shoulder muscles. Gerlach erroneously assigned these conditions to the biceps, but although we are not in a position absolutely to deny their occurrence in this position, yet they are exceedingly rare. Nesbit reported a case in which both biceps muscles were torn away from the coracoid process. Inflammatory symptoms, such as increased warmth, pain on pressure, or on extending the diseased muscles, can almost always be detected on careful examination, but care and judgment are required in order to avoid error.

Most horses flinch under strong pressure on the shoulder, nor is tenderness a constant symptom even in painful lamenesses, so that it is quite erroneous to consider that it is simply a question of unequal sensitiveness. Moreover, the affected spot has often been made more sensitive by manipulation, or by the application of irritants. On the other hand, inflammation occurs in single muscles, like the levator humeri, and even in entire muscular groups, such as the pectoral muscles, in consequence of bruises and sprains, and

in young horses from severe exertion, and can only be detected by careful palpation. On drawing the foot backwards, the animals show pain.

These conditions are usually accompanied by lameness while the limb is being advanced, though none is shown when weight is placed on it. After some time muscular atrophy sets in, and is most marked in the region of the diseased muscles.

Rheumatic disease of the shoulder muscles, which is especially common in the levator humeri, produces similar symptoms. Pain generally diminishes during movement, and may entirely disappear when the animal begins to sweat. Rheumatic disease is indicated by remittent or intermittent lameness, and by unusual pain after slight sudden movement of the muscles, such as that produced by flipping the parts with the finger, whilst powerful pressure is less painful. Sometimes extensive contraction can be induced in single muscles, *e.g.*, in the levator humeri, by a light blow with the finger. In disease of this character in the levator humeri, the animal's neck is drawn downwards and towards the diseased side (*torticollis*), and the muscle appears very tense and prominent.

Pütz saw a peculiar shoulder lameness: movement was difficult, though the animal showed no pain on examination. The muscles were swollen but relaxed, the body sank between the limbs, and the shoulder-joint was pressed away from the thorax. Post-mortem examination discovered a *myositis chronica fibrosa*, produced by the presence of parasites.

Blenkinsop, in Australian horses, repeatedly observed atrophy of the pectoralis anticus. A deep depression was present in the pectoral region, especially noticeable when the limb was drawn backwards. The diseased leg was advanced when moving, without, however, being extended. The shoulder-joint was turned outwards, the elbow inwards; below this point the limb was abducted, and trailed during forward movements.

Rupture of shoulder muscles has often been seen in horses. Di Nasso had a case of rupture of the serratus anticus major, subscapularis and pectoral muscles from collision with a tree. On placing weight on the limb the shoulder-joint was rotated outwards—a sign of paralysis of the suprascapular nerve. A similar case has already been described under the heading “Paralysis of the Suprascapular Nerve.” In horses shoulder lameness may also be produced by over-extension and partial rupture of the superficial pectoral muscles, due to falling or slipping.

Rigot several times noted rupture of the subscapularis muscle in horses, in consequence of the limb slipping outwards. As a rule, the tear occurred near the lower insertion, and was followed by formation of exostoses on the humerus. The following case was due to rupture of the triceps. A riding-horse suddenly fell lame on the off fore-leg when turning sharply.

The lameness increased with movement, and was distinguished by the lame leg being so much adducted that it crossed the other leg. Seven weeks afterwards the animal was killed as incurable.

There is no difficulty in diagnosing such cases, but the prognosis can only be based on a thorough knowledge of the local anatomical changes.

(3) Shoulder lameness may be caused by disease of the scapula or humerus. Though fractures are generally easy to recognise, fissures may elude the closest examination. Periostitis and the formation of exostoses are common on the scapula and humerus.

Gerke, in making a post-mortem of a horse which had suffered for two years from shoulder lameness, found an exostosis on the inner side of the head of the humerus. The connective tissue surrounding it appeared thickened, and formed, along with the exostosis, an "extraordinary articular surface." The radial nerve was smaller than on the sound side. The horse moved the limb in circles, but could still place weight on it. The lameness only occurred at a trot, but did not disappear with work. Similar cases have repeatedly been seen.

(4) Thrombosis of the brachial artery produces lameness, which regularly recurs with work, and can, therefore, be easily recognised. It is rare, but has several times been seen in horses.

An old Percheron mare appeared lame on being rapidly trotted or worked in a cart. At first there was only stiffness, but in about ten minutes both fore-limbs began to tremble, and thereafter to give way, the animal threw the head and neck violently upwards, and seemed doubtful which leg to stand on; the respiration and pulse were increased, and sometimes general sweating followed, though the fore-limbs remained dry. These symptoms disappeared after a quarter to half an hour's rest, but always recurred on movement. Post-mortem examination showed thrombosis of both brachial arteries, which were much thickened.

Möller saw a similar case in a seven-year-old mare. When resting she showed nothing whatever unusual, though careful examination revealed hypertrophy of the heart. After ten minutes' trotting the mare began to place the fore-feet abnormally far forward and outward and to stumble. The off fore-limb was especially affected; the toe often struck the ground, causing the animal to stumble and fall; on rising, the legs were propped out and the muscles trembled, particularly the triceps. All these symptoms disappeared after five to ten minutes' rest, to return again on exertion.

Many similar cases have been seen and verified by post-mortem. A horse which suffered from obstruction of the femoral artery began to show symptoms of radial thrombosis; during movement, the radial symptoms set in later than the femoral, but lasted longer, persisting for even half an hour. Post-mortem showed thrombi in the arteria subclavia, arteria axillaris, brachialis and radialis, and even in the metacarpal arteries. The muscular coats were thickened, and the intima altered in character (endoarteritis).

Martin saw thrombosis of the axillary artery followed by gangrenous

inflammation of the muscles of the limb, hypertrophy of the heart, and fatty liver. The disease appeared suddenly, with symptoms of fever, and proved fatal in eighteen hours. The case closely resembled septic cellulitis or malignant oedema.

(5) Inflammatory swelling and new growths sometimes interfere with movement. Thus acute or chronic swelling of the prescapular and axillary glands, resulting from glanders, strangles, or infective local disease of the fore-limbs, may cause shoulder lameness. Gerke reports several cases of the kind.

A horse, lame for two years and a half, showed on post-mortem a swelling as large as a man's fist beneath the shoulder, surrounding the axillary plexus. Another, which had suffered from shoulder lameness for four years, exhibited swelling and degeneration of the axillary glands. In both cases there was excessive atrophy, not only of the muscles, but even of the hoofs.

In these conditions the limb is often abducted, both during movement and when weight is placed on it. Intermittent shoulder lameness may be caused by swelling of the axillary glands. Chronic inflammation and suppuration in the skin of the shoulder may produce such swelling of the lymph glands. Scholz found an abscess near the axillary artery in a horse which had suffered from metastatic strangles, and subsequently from lameness.

(6) In addition, shoulder lameness may be produced by lesions of the nerves, as in suprascapular paralysis.

The diagnosis of "shoulder lameness" chiefly depends on the negative results of local examination; the more careful the local examination, the rarer will be the diagnosis shoulder lameness. The practitioner should avoid basing his opinion on single symptoms, or attaching too great weight to the indications of palpation. As the striding movement is chiefly dependent on the action of the shoulder muscles, it is naturally much interfered with, and therefore shoulder lameness is generally characterised by difficulty in advancing the swinging limb. The stride is shortened, and, as a rule, uncertain. The foot is imperfectly lifted; it tends to strike the ground, especially when the surface is uneven, or when the foot meets with obstacles. In leading the horse uphill, or in circling (especially if the lame leg is inwards), lameness is generally more marked. The limb, when being advanced, is not infrequently turned outwards. Lameness appears equally on hard and soft ground—in fact, may even be more marked on the latter. When trotting, the head is often nodded in a pronounced way, but even this symptom is not constant. It is generally present, however, in disease of the levator humeri, and of the other extensors of the shoulder, because of the pain induced

by contraction of the affected muscle. In moving backwards, the lame leg is often not lifted, but dragged over the ground. Disease in the levators of the fore-arm produces marked pain when the foot is passively moved either forwards, backwards, inwards, or outwards. In chronic lameness, too great stress must not be laid on atrophy of muscle or of contraction of the hoof. Both are secondary symptoms, and do not always indicate the seat of disease.

Prognosis and course. Our ignorance of the nature of this lameness renders prognosis uncertain, and the chief indication is the course which the disease takes. The longer lameness has existed and the greater the atrophy of muscle, the more serious the condition. Inflammation of a single muscle generally takes a favourable course, but rheumatic disease is often obstinate. None of the articular diseases offer much hope of recovery, especially when of old standing. As soon as some improvement can be noted, a more sanguine prognosis may be delivered. Many cases of shoulder lameness recover in two or three weeks, whilst others may continue for an indefinite time.

The treatment is as varied as the prognosis. In acute inflammation and mechanical injuries, rest and cold applications in the form of irrigation are most useful. Failing marked improvement in eight to fourteen days, a powerful douche may prove serviceable. At a later stage, irritants may be tried, and in the event of their failing, setons. The long rest thus ensured has a very important influence in determining recovery. When massage can be properly applied it should have preference, especially in disease of soft parts, as it assists resorption of inflammatory products, increases nutrition of muscles, and prevents atrophy.

Antiseptic fomentations or poultices are also useful, particularly in the inflammation following injury or rheumatic disease. Subcutaneous injections of veratrin are also worth a trial. There is no doubt that veratrin affects the functional activity of muscle, and assists metabolism. In shoulder lameness due to muscular rheumatism exceedingly good results often follow veratrin injections. Veratrin that is insoluble in water should be used, because it is less rapidly absorbed, and therefore produces a local effect. Wonderful results are said to have been produced in some cases by the subcutaneous injection of the following solution: Atropin sulphate .75 grain, morphine hydrochlor. 3 grains, water 300 grains. Failures, however, are not infrequent, and in some cases fatal colic is said to have occurred, which has been attributed to the atropin. If this treatment be tried, the animals should be fasted for 12 hours

beforehand or the dose of atropin diminished. Möller saw no good results from subcutaneous injection of common salt. A pure solution produces no visible effect, whilst if the solution or syringe is dirty, extensive pus formation may ensue; whatever efficacy the treatment has, apparently, depends on its causing purulent inflammation. The same objection applies to injections of turpentine and ether; and as they occasionally produce violent local action and necrosis, their employment is dangerous.

B. DISEASES OF THE ELBOW AND FORE-ARM.

I.—FRACTURE OF THE ULNA.

THOUGH seen in all species of animals fractures of the ulna are rather rare except in horses. In horses the olecranon is generally broken, in other animals the strongly developed body, as a consequence of external violence, in the form of kicks, treads, or falls. Jansen reports three cases, one caused by falling and sliding along the ground and two by kicks. Double-sided fracture of the ulna was seen in a horse which had passed the fore-feet through a hay-rack. In general the olecranon breaks completely off, loosening the lower point of insertion of the extensors of the elbow, and producing symptoms like those of radial paralysis.

Birrenbach saw complete fracture about $1\frac{1}{2}$ inches below the joint. When, as is generally the case, the fracture extends into the elbow-joint, lameness and pain are severe when weight is placed on the limb. The displacement of bone can sometimes be directly observed.

Mann noticed permanent lameness and symptoms of radial paralysis in a foal which had been kicked on the elbow. Post-mortem showed that the ulna was completely broken off from the radius, and that a space of nearly two inches existed between them. In this case the transverse and interosseous ligaments must have been ruptured.

Prognosis and course. Union of transverse fracture of the ulna is rare; most horses suffering from it have sooner or later to be



FIG. 463.—Fracture of the ulna in a horse.

killed. Günther says foals recover. In man, transverse fractures of the olecranon only reunite by fibrous callus, because, it is said, of the displacement of broken fragments by the pull of the muscles, and of the failure to form bony callus on account of the absence of periosteum. On the other hand, A. Cooper has shown by experiments on dogs that in longitudinal fracture of the olecranon a bony callus always forms. The unfavourable course which transverse fracture of the ulna takes in the horse must be referred to the great dislocation produced by the pull of the triceps muscle, and to the fact that the fracture almost always extends to the articular surface. Fig. 463, drawn from nature, shows a typical fracture, such as is usually seen in horses. Möller never had a recovery. Under exceptionally favourable circumstances, fracture of the ulna may reunite. In pigs, dogs, and cats, in which the ulna forms a bone distinct from the radius, recovery is much commoner, the radius acting to some extent as a splint for the broken ulna.

Treatment. As in horses and ruminants no effective bandage can be applied at this point, treatment is confined to keeping the animal quiet, or possibly to placing it in slings. The action of the triceps muscle interferes with healing, and therefore it is best to prevent animals lying down, and in horses this is easily effected by slinging or by fastening them up short. In carnivora a plaster bandage assists recovery, but is somewhat difficult to apply. To ensure its remaining in place the bandage should be passed over the back and between the fore-legs, reversing the direction alternately.

II.—FRACTURE OF THE RADIUS.

In the horse, fracture of the radius is not usually accompanied by fracture of the ulna. In other animals it is sometimes seen with, sometimes without, fracture of the ulna. In dogs the fore-arm is most frequently fractured by the animals being run over, or being squeezed or kicked; in larger animals it results from kicks, falls, and slipping whilst getting up, &c. Freer, in a horse, saw fissuring of the radius which, a fortnight later, was fractured.

In ruminants and carnivora, **diagnosis** is only difficult when the ulna remains intact, and crepitation is absent. Careful examination, however, shows abnormal mobility, crepitation, swelling, and pain. Not infrequently the broken ends perforate the soft tissues and produce a compound fracture.

Prognosis and course. Subcutaneous fractures of the radius

with intact ulna unite, in carnivora and ruminants, in three to six weeks. Should the ulna be simultaneously fractured, proper treatment may be succeeded by recovery in four to eight weeks; and although in ruminants and swine repair is more difficult, it is by no means impossible. In horses, however, complete fractures of the radius must be viewed as relatively incurable, particularly when impacted, or near the epiphysis; in oblique fracture of the diaphysis, recovery may occur if the animal can be kept perfectly quiet, and if able to stand long enough on the other leg.

An English thoroughbred mare with transverse fracture of the radius and rupture of the carpal ligaments recovered sufficiently for breeding purposes.

Compound fractures of the radius in the horse must be viewed as incurable, though in small animals they are rather more hopeful.

Treatment. Reduction is effected according to the general principles already laid down, and succeeds best under anæsthesia. Before applying the plaster bandage, the operator must make sure that the leg occupies its normal position, and is neither in a condition of supination nor of pronation. The position of the other leg should guide the dresser. In carnivora, the plaster bandage includes both the elbow- and knee- joints. In larger animals it must reach at least to the knee, and to prevent its sliding down for want of a fixed point, the shank and pastern should be covered with a stable-bandage.

Large animals should be kept in slings. Ordinary splints are seldom of much use, but felt and poroplastin have been used with advantage. In treating an oblique fracture, the animal was placed in slings on the second day, reduction effected, and after applying wadding and gauze bandages, a piece of moistened felt was fixed in position by linen bandages. Complete recovery followed in three months. A number of successful cases in the horse have been reported by French practitioners. In most instances after reducing the displacement the limb was enveloped in masses of tow, saturated with white of egg and alum, or in bandages treated with a resinous solution. Over these were applied wooden splints, retained in position with a further series of bandages. In some cases it was found needful to pass the bandages over the shoulder in order to prevent the dressing slipping down. Some operators used plaster bandages. The dressings were left in position for one to two months. A more or less extensive callus remained, and the horse usually continued lame, but in the majority of reported cases became sound after firing. It must not be forgotten, however, that the failures

are less often reported than the successes, and the former probably exceed the latter at least tenfold. Complicated fractures are treated on general principles.

III.—LUXATION OF THE ELBOW-JOINT.

In large animals, luxation of the elbow-joint is impossible without previous rupture of the powerful lateral ligaments; in the horse, fracture of the ulna is then usually produced. According to Rigot, luxation occurs during flexion, on account of the force acting on the ulna. It is exceedingly rare in animals. Such cases have, however, been described in the horse. In one the internal lateral ligament was ruptured in consequence of a fall. The limb could be abducted to an abnormal degree. The horse recovered almost perfectly; in five weeks only a slight "swinging leg" lameness was noticeable.

A mule carrying a very heavy load of barley slipped and fell. The left leg, from the elbow downwards, was doubled under the body, and when the animal was lifted the head of the radius and the ulna were thrust to the inner side of the inner condyle of the humerus; that is to say, the lower extremity of the humerus overlapped the upper end of the radius.

In another case a horse fell on its left side, with the corresponding leg in a doubled-up position; on rising the fore-arm pointed obliquely forwards and outwards, the limb below the fetlock hung limply downwards. In this instance the head of the radius was outside the condyle of the humerus.

Luxation of the radius outwards in dogs has been referred to the fact that the articular surfaces slope downwards and inwards, and the internal lateral ligament is particularly strong.

Distortion is very uncommon, on account of the effective limiting apparatus of the joint—the strong lateral ligaments and beak of the ulna. Hertwig insists that in carnivora both complete and incomplete displacement may occur in the elbow-joint, and either inwardly or outwardly, without fracture. Möller only saw such displacements as congenital conditions, occurring simultaneously in both limbs, and associated with deformity both of the elbow- and knee-joints. The animals are generally killed as hopeless cripples.

The diagnosis of displacement is not difficult, as there is always extensive rupture of soft tissues.

Prognosis and course. In carnivora, cases do well provided they are treated early and the joint is not involved. The mule and one

of the horses above mentioned are said to have recovered after reduction of the luxation, but the statements require confirmation. Congenital luxation is unpromising, and in direct proportion to the amount of deformity present. Even if the bones can be replaced, retention is very difficult, and treatment can scarcely be advised.

Treatment. Reposition and retention are effected under anæsthesia and in accordance with general principles. In carnivora, the joint may be supported by plaster bandages ; in large animals this is impracticable.

IV.—INFLAMMATION OF THE ELBOW-JOINT.

ACUTE inflammation of the elbow-joint is seen in all species of animals, sometimes from wounds of the joint, sometimes from metastatic disease, like “navel-ill” of young animals. In dogs the joint may be opened by bites, in horses by contused wounds, or by injuries from stable-forks. Disease may also be caused by injury to the sheath of the flexor metacarpi externus, which communicates with the elbow-joint. Franck states that this sheath always opens into the elbow-joint by a slit about 1 line in breadth. Lothes saw chronic inflammation of the elbow-joint in a horse, apparently produced in the first instance by an injury to this sheath. Lanzillotti treated a horse which suffered from necrosis of the radius in consequence of a kick. During operation for removal of the sequestrum the elbow-joint was opened, but under antiseptic treatment healing occurred.

Chronic inflammation of the joint is rare. Roloff noticed fungous arthritis of the elbow-joint in the horse ; Dammann, a cystic enchondroma. As a rule, tumour formation is not frequent. Arthritis chronica is difficult to diagnose with certainty, and is generally included in “shoulder lameness.”

Percival noted a form of chronic lameness in the horse which presented considerable resemblance to laminitis. Post-mortem showed chronic inflammation of both elbow-joints, a portion of the articular surface being worn away and replaced with granulations.

Symptoms. Acute inflammation of the elbow-joint due to wounds produces excessive pain on movement. The patient may sustain weight on the limb, but carefully avoids any movement of the joint, particularly at the commencement, when acute synovitis alone exists. Afterwards fever and marked swelling of the whole joint set in.

The course is often unfavourable, acute inflammation of this joint frequently ending in slaughter of the patient, and chronic

inflammation may be followed by incurable lameness. When the joint is not infected, careful antiseptic treatment of the wound and its surroundings often results in recovery. When the joint is suppurating there is little hope of any treatment being successful.

Treatment is chiefly of a prophylactic character, and follows general principles, including careful antisepsis of any wound in the region of the elbow-joint. In open arthritis the horse should be placed in slings, and continuous irrigation applied to the elbow. If the wound is small sutures covered with an adhesive or a synovial styptic (sublimite in fine powder), may be tried to prevent further escape of synovia. When the wound has closed a blister may be applied. In suppurating cases antiseptic injections sometimes succeed in effecting recovery, otherwise little can be done. In dogs, wounds of the elbow-joint are always amenable to treatment; antiseptics, adhesives and bandages can be successfully employed, and recovery is the rule.

V.—CAPPED ELBOW IN THE HORSE.

THE structure corresponding to the bursa olecrani of man is found in the horse and dog at the posterior surface of the elbow-joint, and though not constant, generally forms below the skin a bursa mucosa as large as a walnut or small apple. Injury caused by the heel of the shoe may result in local infection and produce a swelling, commonly termed "capped elbow."

Pathological anatomy. Bruising leads to acute inflammation of the bursa; sometimes bleeding takes place into the bursal cavity; sometimes bursitis sero-fibrinosa vel hæmorrhagica occurs. If pus cocci enter suppurative bursitis results. The connective tissue around the joint also suffers (parabursitis), and in some cases this condition constitutes the main cause of the swelling. At first, œdema of the connective tissues sets in, but later gives place to plastic infiltration, and finally to extensive formation of fresh connective tissue which becomes indurated. The disease, therefore, consists of a bursitis and parabursitis olecrani, the swelling being chiefly caused by the latter.

Symptoms. The clinical symptoms differ somewhat according to the pathological changes and the age of the enlargement. The only constant feature is the swelling, which is more or less sharply differentiated from its surroundings. When recent, it feels abnormally warm, is doughy and slightly painful. It afterwards becomes harder, depending on the degree of plastic infiltration and induration of parabursal tissue. Frequently distension of the bursa is a prominent

symptom, and the swelling is then fluctuating, and on being opened discharges blood-stained fluid. The bursa may become as large as a man's fist and contain fibrinous clots. If not opened, its contents may be partly reabsorbed, and whilst the parabursitis disappears, the over-stretched skin forms a loose fold. Lameness is rare, and the condition can only be mistaken for inflammatory changes in the



FIG. 464.—Capped elbow.

subcutis, which, however, are never so sharply defined as is the inflamed bursa.

Causes. Capped elbow is produced by bruising, often due to lying on the heels of the shoe, though sometimes to contact with the floor. Weakness, too short a halter rein, too small a box, and in broken-winded horses, difficulty in breathing, may all cause the animal to rest on the sternum, with the legs tucked under it; in animals with short fore-arms the posterior surface of the elbow then comes just against the posterior part of the hoof, and is readily bruised by the heels of the shoe. Capped elbow, however, is not infrequently

seen in horses shod with short shoes, or "tips," and in horses without shoes at grass, so that the shoe cannot always be blamed. The position assumed by the horse when lying or about to rise (elbow and foot position), is of great importance in determining the condition. Metastatic disease of the bursa is sometimes seen during strangles.

Course. Capped elbow is generally produced in a single night. By immediate treatment the swelling may sometimes disperse, but more frequently it becomes chronic, resorption being incomplete, and induration occurring in the parabursal tissue. When a large swelling disperses after existing for some time, a loose fold of skin remains, which detracts from the animal's appearance. Resorption, however, is not infrequently prevented by further bruising. The animal may continue to lie in the position described, repeating the injury, and chronic thickening may occur in the parabursal connective tissue, rendering resorption impossible.

When the skin is injured suppuration may occur in the bursa, and after some time be followed by fluctuation and perforation. Metastatic bursitis produced during strangles is always of this character. As the disease seldom causes lameness, prognosis in working horses is always favourable as far as continued usefulness is concerned. The older the condition the less the chance of complete recovery, but firm swellings can be removed with the knife.

Treatment. An excellent preventive consists in causing the horse to wear a stout cushion extending across the chest just behind the elbows. This cushion, if applied regularly every night, sometimes causes small capped elbows to disappear. Another mode of prevention is to apply a well-padded "boot," covering the heels, or to strap a thick straw pad extending above and below the knee to the back of the limb. This checks the animal when it attempts to flex the knee, and prevents it taking up the undesirable position. Shoeing the fore-feet with bar-pads often succeeds when other means have failed.

Fresh swellings are treated by cold applications, and if further bruising be prevented, complete dispersal often results. Resorption is assisted by repeatedly applying irritants, which favour resolution. At the same time they render the skin sore, and thus prevent the animal lying on the diseased spot and renewing the injury. A 10 per cent. iodide of mercury ointment may be applied every two or three days.

When the swelling fluctuates it may be opened at the lowest point, the contents pressed out, the cavity flushed with iodine solution and

a gauze drain inserted to prevent refilling. In spite of this treatment some thickening remains and further bruising is followed by rapid increase of the swelling which soon becomes indurated. Möller does not advise opening the bursa except when it contains pus. Cadiot considers that puncture is only useful when it is followed by destruction of the cystic-lining—for which purpose he prefers the cautery ; while others scrape the lining of the cavity with the curette.

Stockfleth recommends swabbing out the cavity daily with 1 part of caustic potash to 4 of water ; the other parts of the leg must, of course, be protected against the irritant. The use of the actual cautery seems simpler. Stockfleth employs it to open the inflamed bursa, thus preventing the emphysema which sometimes follows incision. The bursa should only be opened when pus exists in it, or when its walls are very thin, and the contents fluid. Hardness of the swelling shows that it principally consists of indurated connective tissue, and treatment is then limited to destroying or excising the newly-formed material. At one time the first method was largely adopted, arsenic or other irritants, in the form of powder, being passed through an incision as far as the centre of the swelling. Necrosis occurred in the bursa and its surroundings ; after eight to fourteen days, the swelling sloughed, and eventually the wound was filled by granulations and healed. Though this method has certain advantages, yet it may cause serious complications, and therefore operative removal, either by dissection or by ligation, has latterly received preference.

Ligation is a simple and easy method, and is almost always successful. When the tumour is sufficiently pedunculated to allow an elastic ligature to be applied, it is the method most used by Continental operators. After cutting away the hair and cleansing the skin, a rubber cord, about the thickness of a quill, is passed round the base of the swelling, and drawn as tight as possible. The ends are tied together with string. The ligature soon begins to cut in, and in four to ten days, according to the thickness of the tumour, it falls away. In large tumours it may be necessary to remove and reapply the ligature after two or three days. The surface of the wound should meanwhile be cleansed daily and washed with disinfectants such as sublimate or carbolic solution. On account of its deodorising qualities, permanganate of potash is especially useful. As a preventive measure, careful disinfection is advisable, while at the same time it destroys the unpleasant smell of the mass of dead tissue. Möller prefers passing the ligature over the skin, which is not previously cut through ; the skin is thus drawn together,

and cicatrization reduced to a minimum. Should the application of an elastic ligature prove difficult, on account of the tumour having too broad a base, a thin cord may first be applied, as it does not so readily slip off as the elastic ligature. In a few hours the tumour swells, when an elastic ligature can be put on with ease. In case of need, slipping may be prevented by passing a long needle completely through the swelling in front of the ligature.

In using the ligature, the remainder of the tumour must not be cut away with knife or scissors, as bleeding may result. When a cord is used, it will be necessary to tighten or renew it after a couple of days.

After-treatment is simple. As soon as the swelling has fallen off (which may be somewhat assisted by torsion slowly performed), the surface of the wound should be cleansed daily with disinfectants until a dry scab has formed, under which healing occurs in eight to fourteen days, without leaving any considerable cicatrix. Formation of a scab will be promoted by powdering the parts with iodoform combined with tannin. Until healing is complete, the horse should remain in slings.

Enucleation is eminently "surgical," and Dollar prefers it in the majority of old-standing cases. In this operation the horse must generally be cast, and if restless, placed under chloroform, though it is possible to remove large growths without casting by previously injecting a few minims of 5 per cent. cocaine solution at a number of points around the base of the tumour. If the horse has been cast, the foot is loosened and drawn forward by two cords, or fastened by a modified "side stick," and a ligature passed through the swelling to afford a better hold. In clipping or shaving the parts an oval-shaped "island" of hair may be left to indicate the area of skin subsequently to be removed; otherwise the skin may be displaced and the operator may make an asymmetrical incision. The tumour is next separated in the ordinary way. Care is required, however, to avoid injuring the fascia of the fore-arm and the muscular tissue, which might easily produce cellular inflammation, nor should the point of the elbow be exposed. After removing the growth, the wound is treated on general principles. As asepsis is not always possible, large vessels should be tied, and a tampon of carbolicised jute sewn up in the wound to check bleeding. The tampon is removed next day, and open-wound treatment proceeded with. But, provided care is taken, relative asepsis can often be attained and much better results ensured. In this case Dollar carefully cleanses the interior of the wound, rinses it with 1 in 1,000 biniodide

of mercury solution, and powders it with iodoform, leaving the flaps open for six to twelve hours. When all bleeding has ceased and the surfaces are covered with a serous discharge, he unites the flaps with two series of sterilised silk sutures ; one set being used to bring together the edges of the skin, and the second set, consisting of two or three sutures only, being passed further from the edges and used to obliterate any "dead space." If thought necessary, a drainage-tube is inserted. Others, after dissecting out the growth, treat the wound by continuous irrigation with cold water, which usually results in complete closure in about three weeks. The horse should be kept in slings until the wound has cicatrised, and afterwards the horse, when in the stable, should wear some form of preventive pad.

A similar disease occurs in large, heavy dogs, which, when lying on hard ground, support themselves on the sternum and elbows. The skin alone may be injured and thickened, or callosities form at the affected spot, but occasionally the bursa olecrani becomes inflamed. The disease is nearly always confined to chronic inflammation of the bursa, parabursitis occurring very rarely, and the swelling is soft and fluctuating. Symptoms of acute inflammation (warmth and pain) are in rare cases present ; but, as a rule, there is only a fluctuating swelling of an oval or round form, varying from the size of a hazel-nut to that of a hen's egg.

The swelling is produced by distension of the bursa olecrani with fluid, which sometimes contains fibrin (bursitis sero-fibrinosa) ; blood is rarely met with. It never interferes with movement, but is a blemish which is difficult to remove, the cause being always at work. Animals accustomed to lie in the position described cannot be broken of the habit, especially as the swelling is painless. Simple puncture and removal of contents are therefore not sufficient, and, owing to the flatness of the swelling, a ligature cannot be applied. If necessary, the enlarged bursa must be surgically removed, though operation is difficult, and, as a rule, cicatricial thickening remains. Before operating, it is best to give a dose of morphine. The hair is removed and an incision made over the swelling in the long axis of the limb. The bursa is then separated from neighbouring parts, care being taken not to incise it, which would greatly increase the difficulty of the operation. The greatest precaution is required in separating the bursa from the elbow, with which it is firmly united, and the bone must not be exposed, as this would delay healing, and prevent the formation of a cicatrix. When excision has been successful, it is sometimes possible, by observing antisepsis, to produce healing by first intention. The operation wound is carefully dressed and

thick layers of wadding or wood-wool applied to the posterior surface of the elbow to prevent further bruising when the animal lies down. When healing by first intention is impossible, the wound must be treated on general principles. A soft bed is particularly requisite. Remnants of the bursa, which remain after enucleation, may be destroyed by irritants like nitrate of silver, and a proper granulating surface so produced.

VI.—WOUNDS AND BRUISES OF THE FORE-ARM.

In the horse, the fore-arm (antibrachium) has, as a basis, the radius and ulna, which are surrounded by numerous muscles, tendons, and fasciæ. The following surface-markings should be noted:—Towards the outside at the lower extremity a depression, slightly inclined backwards, and marked in its centre by a prominent cord, the tendon of the extensor suffraginis. Behind this depression lies the flexor metacarpi externus, which is bounded behind by the flexor metacarpi medius. In front of the extensor suffraginis runs another cord about an inch in breadth, the tendon of the extensor pedis. Towards the front of the limb, and at the boundary of the external and anterior faces, another depression, and still further inward, the tendon of the extensor metacarpi magnus.

The inner surface of the fore-arm shows another depression, at the bottom of which can be felt the radius, here only covered by skin and fascia. Behind it lies the flexor metacarpi internus, readily felt below the skin: in front of this furrow, the bone is margined by the extensor metacarpi magnus. Between the two depressions, and quite clearly visible, runs the internal subcutaneous or radial vein.

Two fasciæ cover the fore-arm, a thin superficial and a deeper, better developed layer, the fascia antibrachialis, which arises from the various muscles of the humerus and shoulder, is attached partly to the subcutaneous portions of the radius, partly becomes continuous with the tendons of the extensors and flexors, and partly extends to the ligaments of the knee. Between the skin and fasciæ pass the thin cutaneous nerves; those on the posterior surface of the fore-arm rising from the ulnar nerve, those on the exterior from the radial nerve, and those on the anterior partly from the median.

Vertical wounds confined to the skin of the fore-arm are of no particular consequence, but horizontal wounds are more apt to cause trouble on account of their gaping. If carefully disinfected, primary union may result from applying a proper dressing, which, however, is more difficult in large than in small animals.

Injury of the muscles of the fore-arm is frequently followed by infiltration of pus beneath the fasciæ and other dangers, for which reason such wounds must be dressed antiseptically or freely laid open. Sometimes counter-openings or drains are useful, especially in penetrating infected wounds accompanied by much swelling and pain. Fever is a particularly dangerous symptom.

The edges of horizontal muscular wounds are apt to gape excessively. The animals generally walk lame, though able to stand on the limb, especially when the chief seat of injury is in the extensor muscles. Gaping of the wound and contraction in the divided muscles alike impede union; and as, in large wounds, the skin soon retracts, it is best, even when asepsis seems out of the question, to suture such wounds as soon as possible. Sterilised tape about $\frac{1}{8}$ of an inch broad forms a good suture material, and an attempt should be made to fix the skin and prevent it retracting. By passing the suture through the bodies of the muscles a better hold is ensured, and there is less chance of their tearing out, whilst the tapes may be used for fastening on a dressing. Any tendency to excessive granulation must be repressed early by using astringents and dry dressings.

Bruises of the muscular tissue and fasciæ of the fore-arm, commonest in cart-horses and caused by kicks or blows, are easily recognised by the pain, swelling, and difficulty in that phase of movement when the limb is carried. Resolution generally occurs and lameness disappears in eight to fourteen days. In other cases abscesses form, and should immediately be incised to allow free exit of pus, which may otherwise burrow and cause necrosis of the fasciæ of the fore-arm; extensive counter-openings are therefore at times necessary. The radius is sometimes injured just above the knee. In this case also it is important to provide for drainage, either by counter-incision or drainage-tubes. Slight swelling with great pain points to disease of the bone (periostitis or necrosis), a complication which may occur at any time before pus formation has completely ceased.

In horses, the inner surface of the elbow-joint may be injured by straddling across bales, poles, or similar objects. The pain is often so acute that the animals are unable to place weight on the limb. In these cases the median nerve is bruised; and although the effect of the injury may only last a few minutes, it may also continue for a couple of days. The pathognomonic symptom is insensibility below the elbow-joint, especially at the posterior surface of the limb. The affection soon disappears.

Bassi in a mule saw movements of the left fore-foot simulating stringhalt. The front foot was lifted unusually high, and the animal often stumbled; the symptoms were particularly noticeable when the animal moved backwards. On the external surface of the fore-arm, just below the elbow, was a thickening, the result of a fall; it was not inflamed, and had existed for some weeks. The

difficulty in movement had first appeared twelve to fifteen days after the fall. Permanent recovery followed division of the flexor metacarpi externus.

C. DISEASES OF THE KNEE.

The knee, a composite joint, consists of three principal and several subsidiary articulations. The principal joints are:—(1) the radio-carpal articulation; (2) the inter-carpal articulation; (3) the carpo-metacarpal articulation.

The first two are incomplete ginglymoid joints, because, in addition to flexion and extension, they allow of slight lateral movement, and, in the flexed position, of some amount of rotation, most marked in carnivora. The lower row of bones forms with the metacarpus an arthrodial joint, the movement of which, in all animals except carnivora, is exceedingly limited. Each of these three joints is surrounded by its own synovial membrane, though the lower is connected with the middle by a narrow slit.

The anterior capsular ligament arises from the radius, is applied to both rows, and ends on the metacarpus. Two strong lateral ligaments attach the radius to the metacarpus, while the bones of the carpus itself are united to one another and to the radius and metacarpus by interosseous ligaments which limit the movement of the knee-joint. A strong fibrous expansion protects the joints behind.

The fascia covering the carpus and metacarpus, which is an extension of the deep portion of the fascia of the fore-arm, forms, on the anterior surface of the knee-joint, sheaths for the extensor tendons, and is in close connection with the capsule of the joint. On the outer surface of the carpus the fascia becomes continuous with the ligaments of the joint, with the periosteum of the external surface of the pisiform bone, with the tendon of the flexor metacarpi externus, and with the extensor pedis. On the inner side of the carpus the fascia becomes attached to the ligaments of the joint, to the lower extremity of the radius, and to the inner small metacarpal, and posteriorly it covers the carpal arch and the flexor pedis tendons.

The skin lies immediately over the fascia, and on the dorsal side especially, is thick, tense, and provided with a moderately well developed subcutis. In addition to the synovial sheaths of the extensor tendons, subcutaneous bursæ are sometimes found on the os magnum, as well as on the lower anterior surface of the radius towards the inner side of the sheath of the extensor pedis. The discharge of synovia after injury to the front of the knee is therefore no proof that the knee-joint has been opened, although it always calls for special precautions in treatment.

I.—FRACTURES OF THE BONES OF THE KNEE.

FRACTURE of these bones is in general prevented by their small size and sheltered position. In large animals like horses, fractures are commonest from falls on hard ground. They usually occur in

conjunction with wounds and injuries of the joint, *i.e.*, they are compound, and the fragments seldom unite; but when this does occur movement of the joint is more or less limited, or altogether prevented by ankylosis.

On account of its isolated position the pisiform bone is an exception to the above rule, and Möller has repeatedly seen fracture of it in race-horses. A case occurred in a draught-horse during heavy work, the immediate cause being excessive contraction of the flexors of the knee. One or another of the ligaments of the pisiform bone may also be ruptured.

The symptoms are, inability to bear weight on the limb which is flexed, as in complete radial paralysis, and local pain. Abnormal mobility of the pisiform bone and crepitation under pressure reveal the character of the fracture beyond doubt. On the other hand, fractures of the other carpal bones produce very ill-defined symptoms: though in most cases the sudden appearance of severe lameness ("supporting leg lameness") and local pain about the knee-joint sufficiently indicates the seat if not the exact nature of the lesion.

Course. Union of fractures of the pisiform bone is difficult. The fragments of bone are drawn upwards by the pull of the attached muscles, and, as in fractures of the ulna, the conditions are unfavourable to callus formation. A fibrous callus forms, generally of insufficient strength, and if the animal be put to work too soon there is danger of relapse. In other cases the knee shows marked dorsal flexion. Even favourable cases last for two to three months; but many horses have to be destroyed in consequence of laminitis in the other foot and of the resulting acute pain, fever, &c. Compound fractures of the knee bones often end in suppurative arthritis and death. Should recovery occur, there is usually extensive callus formation and loss of function in the joint, so that the animals are of little use except for stud purposes.

Treatment. The animal should be placed in slings and reposition attempted, though it is seldom successful. In quiet animals a dressing may be applied, but it is useless in fidgety patients, which can only be given a roomy stall or box, with plenty of bedding, and allowed to lie down, thus preventing laminitis of the other foot. Complete rest is always the first indication in treating fractures of the carpal bones. Compound fractures call for the strictest antiseptic precautions; though frequently the animal has to be slaughtered owing to ankylosis.

II.—INJURIES TO THE ANTERIOR SURFACE OF THE KNEE.

(1.) INJURIES TO THE KNEE IN THE HORSE.

IN falling during movement, horses almost always strike the knee, sometimes producing contusion, *i.e.*, injury not involving a skin wound, but consisting in more or less damage to the vessels and connective tissues between the skin and bones. Capped knee may be contracted in the stable, the knee striking the manger, or the knee may be bruised when the horse, rising like a cow, rests for a minute with the knees on the ground. Lacerated wounds are more common, and vary in gravity according to their extent. Defective conformation, senile weakness of muscular tissue, &c., render animals uncertain on their fore-limbs, and, therefore, inclined to fall; in such case both knees are often injured. The commonest injury is abrasion of the skin. When animals are going fast and only fall for a moment, excoriations and loss of hair may occur, but are of little consequence unless the skin is perforated. Serious abrasions, however, require rest and careful treatment, in spite of which thickening and hairless spots often result. Repeated bruising often produces hygroma of the knee, or "capped knee" (see Fig. 465), an indolent, diffuse, uniformly fluctuating swelling, extending over the whole anterior surface of the joint. In time the walls of the swelling become tense and much thickened. The contained fluid often shows fibrinous clots and occasionally rice-like bodies. Frequently infection occurs and the contents become purulent.

Chronic swelling of the tissues in front of the knee interferes with movement. If the knee is bruised when forcibly flexed, as for example by the animal falling, the cutis and subcutis, infiltrated with inflammatory products, may easily be ruptured and a wound produced, which heals slowly with permanent blemishing of the surface.

Injury or exposure of the fascia is also grave. The wound is then much deeper, and contains shreds of the injured fascia. In such cases healing is slow, though finally arrived at by proper treatment. Provided the sheaths of the extensor tendons are not laid open, and swelling and pain remain slight, recovery usually occurs, but wounding or infection of the bursæ constitutes a grave complication. Swelling increases and extends both upwards and downwards; synovia discharges from the wound, the limb is very painful when flexed though weight may be placed on it, and in walking it may only be carried stiffly.

Falls on sharp stones, or on rough, hard ground may injure the

extensor tendons, or even one of the three main divisions of the joint. Although the knee-joint is included in the category of "indolent" joints, *i.e.*, such as only slightly resent mechanical injury, yet severe symptoms may follow such accidents. Pain is sometimes so excessive that weight can only be borne by the limb intermittently, or not at all. The swelling extends over the whole joint, and often far beyond it, synovia or pus runs from the wound, and the patient is more or less fevered. A probe can often be introduced into one or other of the joints, and in the later stages it may be possible to see or feel the articular surfaces, which are rough and eroded. Sometimes crepitation can be detected in bending the joint.

Course. Provided the tendon sheaths are intact, the effects of bruises disappear in from two to three weeks, though they often leave local thickening. Otherwise, and especially if the parts cannot be kept aseptic, recovery may extend over four to six weeks or longer, or the wound may not close. Open arthritis of the knee may heal, but generally the process is accompanied by fever and loss of condition, and followed by ankylosis and obstinate lameness, and in consequence the animal is either destroyed or dies from exhaustion.

The prognosis therefore depends chiefly on the extent of the injury. If the parts can be kept aseptic, which is seldom the case, there is, of course, a much greater chance of recovery, and blemishing is minimised.

Treatment. Provided the injury is confined to the skin, it is sufficient to cleanse the abraded parts and smear them with vaseline or zinc ointment. "Capped knee," when recent and of small dimensions, often yields to warm fomentations or repeated friction with mild stimulants like turpentine and ammonia liniment or camphorated alcohol, but when large is best treated by slinging the horse, and opening the swelling at its lowest point, clearing out fibrinous clots, &c., inserting a drain, and injecting twice daily diluted tincture of iodine. Gentle compression with a rubber bandage assists recovery. Needle firing followed by blistering has also proved



FIG. 465.—Hygroma of the knee resulting from bruising.

successful. Failing success by these methods, excision may be attempted, provided the animal's value justify operation.

Wounds perforating the skin require complete rest, to prevent formation of large cicatrices, and in addition general antiseptic treatment. Very careful asepsis is required where the annular ligament is lacerated or exposed. A circular bandage provided with a dressing should be passed around the knee, being left rather looser above and below, and the animal placed in slings or tied up short to prevent its lying down. Sutures should be used where practicable. Wounds which cannot be rendered aseptic should be left open and treated by continuous irrigation with lukewarm dilute sublimate 1 per 1500, or zinc chloride solution 1 to 2 per cent. Goulard's extract is useful during the first few days, especially when there is much discharge. At a later stage dry dressings like iodoform and tannin, glutol, tannoform, boric acid, &c., may be used to form a dry scab, under which healing proceeds. Excessive proliferation may be checked by the occasional use of dried alum, or 5 per cent. zinc chloride solution.

The treatment of open joint calls for all the resources of antiseptics. Provided purulent infection of the joint has not yet set in, the wound must be carefully cleansed, washed with sublimate or Cofectant solution, and an antiseptic dressing applied; but when suppuration has occurred, the only chance consists in carefully disinfecting the parts and providing permanent irrigation. This may at least be tried, and any special complications treated on general principles. The chief points are to sling the horse, immobilise the joint and observe the most careful antiseptics. In animals of little value, and in cases where there is much suffering, further treatment is scarcely advisable.

Where a valuable horse has, by falling, produced a permanent small cicatrix, denuded of hair, it may be advisable to perform the operation proposed by Cherry, revived by Hunting, and perfected by Vinsot. The object of the operation is permanently to remove the scar, substituting a mere linear cicatrix, which, once covered by hair, is almost imperceptible, even to the trained senses of an expert. To succeed the strictest asepsis is necessary, and for a considerable time the personal attention of the operator is required.

The operating table described on p. 21 is almost indispensable for the operation. Under any circumstances, it facilitates the aseptic precautions and avoids the risks of a straw bed, a fruitful source of wound infection.

The instruments and dressings required include :—Clipping

machine, razor, scalpels, forceps, scissors, suture needles and pins, silkworm gut, iodoform gauze, aseptic wool, tarlatan, and surgical bandages.

The instruments should be of metal and have metal handles. They should be boiled for at least ten minutes, and be placed in sterilised, shallow enamelled iron trays containing 5 per cent. carbolic solution.

1. Aseptic precautions. A few days before the operation, the knee is clipped and washed, then covered with an antiseptic compress, which is renewed daily. The animal is then placed on the operating



FIG. 466.

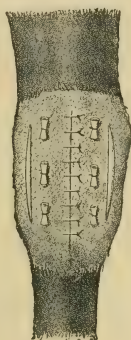


FIG. 467.



FIG. 468.

table and chloroformed. The limb intended for operation is freed, drawn forwards as far as possible, and fixed to the lower bar of the table by means of broad strips of webbing. To ensure the limb being fully extended another piece of webbing is passed round the forearm and drawn forcibly backwards; the knee is thus fully extended. An Esmarch bandage is applied above the knee, to control bleeding, which is seldom troublesome.

The seat of operation is shaved, a lozenge-shaped area corresponding to the part to be excised may be left, however, as a guide to the operator at a later stage. The parts are then rinsed carefully with tincture of iodine and covered with a layer of aseptic wool.

The operator and his assistant having thoroughly cleansed their hands, arms, and finger-nails, the operation, properly so called, begins.

2. The importance of the unshaven area now becomes apparent. Being symmetrical, the edges of the wound traced round it will after-

wards exactly coincide, forming a straight line. It is advantageous to trace this area in a line inclined obliquely to the long axis of the limb. The ultimate linear cicatrix is then extremely difficult to discover. In this way it is possible to remove scars as large as half-a-crown, leaving a very trifling cicatrix. Larger scars may be greatly diminished, though not entirely removed.

The operator makes two parallel curvilinear incisions, meeting above and below the scar as in Fig. 466. He then dissects away the flap from the underlying tissues, removing at the same time as much of the cicatricial tissue as possible, but taking care not to open the synovial sheaths. The base of the wound should be perfectly flat, and hæmorrhage should be stopped by torsion or ligation of the bleeding vessels. If the flap of skin thus removed is so broad as to give difficulty in bringing together the edges of the wound, two lateral incisions may be made (Figs. 466 and 467) in the skin, or the skin may be dissected from the subjacent tissues over the front of the knee. It will then glide easily, and offer much less resistance to coaptation of the edges of the central wound.

3. When bleeding has ceased the surface of the wound is carefully dried with pledgets of aseptic cotton, care being taken to avoid the formation of blood-clots, which check healing. In a few minutes the wound is dry, and the edges can be brought together with pin sutures, or ordinary interrupted stitches of silkworm gut, each inserted about $\frac{1}{4}$ inch from the line of incision and about $\frac{3}{8}$ inch from its neighbour. It is better to commence at, say, the upper extremity of the wound and proceed downwards, than to commence at the centre or at an intermediate point. The surgical knot should be employed. Silkworm gut is the best material for sutures; it is solid, aseptic, non-porous, does not irritate the tissues, and is readily removed at a later stage.

4. The wound being perfectly closed is powdered with iodoform covered with iodoform gauze and a large pad of aseptic cotton wool retained in position by tarlatan bandages. The slightly moist tarlatan readily adapts itself to the form of the limb, and is preferable to any other material. Bandaging should commence low down on the cannon bone, and be gradually continued upwards over the knee.

It being absolutely essential to prevent all movement in the limb after operation, some form of splint is necessary. Plaster bandages have been tried with good effect, but a much simpler and more effective apparatus consists of a "legging" of very stout leather, reinforced by ribs of spring steel and capable of being tightened by

straps. This serves all the purposes of a plaster bandage, is slightly flexible, will not crack, and is less likely to injure the skin. The legging extends from just above the fetlock to 8 inches, more or less, above the knee.

All being well, the dressings are removed about the twelfth day after operation, when, if all details of the operation have been thoroughly carried out, the operative wound is found cicatrised without any sign of pus. The threads may then be cut with scissors and removed with forceps. A light bandage of iodoform gauze, retained in place by tarlatan bandages, is applied for another week, after which time the animal may be exercised in hand or put to light work.

Painful swelling of the limb, or discharge or smell from the dressing during the progress of treatment, points to suppuration. In such case the dressing must be removed, the parts irrigated thoroughly with an antiseptic solution and the dressing renewed. Where stitch suppuration occurs, it is sometimes sufficient to touch the points lightly with iodoform or nitrate of silver.

(2.) HYGROMA OF THE KNEE IN CATTLE.

When lying down and in dwelling on the knees when rising, cattle are apt to bruise the knee, and to produce chronic inflammation of its subcutis, which often leads to great swelling and increase of fibrous tissue. The same result occasionally follows falls on rough, hard ground, in which case inflammation is acute. These swellings were formerly divided into hard and soft forms. A better classification is:—(a) Cutaneous, (b) synovial, and (c) articular or periarticular. This classification, though it cannot always be observed clinically, facilitates the study of the condition.

The cutaneous form consists either in excessive thickening of the skin and subcutis covering the front of the knee, not infrequently associated with active increase in the epidermis covering it (Fig. 469), by which a horny swelling, often as large as a man's head, results, or in the development in the subcutis of cavities filled with serous fluid, which often contains lymph flocculi. Hence the condition is sometimes regarded as "capped knee" and is compared with the retention cysts. The descriptions given indicate that in many cases cysts form in the cutis and subcutis at the same time that the epidermis undergoes active proliferation. Johnes describes this condition as "dermoid cyst, with diffuse keratosis."

The synovial form consists in a *tendovaginitis chronica serosa*

or fibrosa, which sometimes affects the tendon sheath of the extensor pedis, but more frequently the sheath of the extensor metacarpi magnus. The swelling is sometimes chiefly formed by the sheath of the tendon distended with serum (*tendovaginitis chronica serosa*), sometimes by the greatly thickened connective tissue of the sheath and its surroundings (*tendovaginitis chronica fibrosa*). This disease of the tendon sheaths has often been found due to tuberculosis.

A soft and hard form can be distinguished. The tendon sheaths are often greatly distended; in one Gurlt found 17 lbs. of fluid.



FIG. 469.—Knee tumour (cutaneous form), after Stockfleth.

Small papillæ form on the inner surface of the sheaths, and when rubbed off appear like grains of rice; this condition is termed *hygroma proliferum*. Pus formation may also occur.

The articular form presents a true tumour albus, that is, progressive increase and induration in the peri- and para-articular connective tissue, and is always associated with exostosis formation on the bones of the knee, fore-arm, and metacarpus. The swellings are of variable hardness, and result from chronic inflammation of the knee-joint. Ossification in the new connective tissue increases the hardness of the swelling.

Causes. The chief causes are injuries sustained in lying down and rising in badly-paved stalls and on insufficient bedding. The repeated bruising may cause extravasation of blood under the skin, or into the sheaths of the tendons, and proliferation of connective tissue. That bleeding often occurs is shown both by the presence of clots in the serous fluid, and by the pigmented condition of the newly-formed connective tissue. A single severe bruise from falling on uneven, hard ground, as occurs in working-oxen, may produce the disease. Chronic processes, like tuberculosis, invading the carpal joint, may also induce such swellings, but the nature of the cases hitherto reported is seldom fully explained.

Symptoms and course. The chief symptom consists of swelling of the front of the knee, which sometimes increases rapidly, sometimes slowly, but is continued. The growth may become immense (as much as a yard in circumference), and even reach to the ground. The degree of pain varies, sometimes being considerable, but chiefly depending on the mode of origin of the disease. When caused by a single violent bruise it is generally painful; but the slower the development the less the pain. The swelling, though at first soft and fluctuating, at a later stage becomes firm, and is often covered with thick masses of horn. In cutaneous "capped knee" the tumour remains movable on the subjacent tissues for a long time; in the synovial form it takes an elongated shape corresponding to the direction of the sheaths of the tendons, and extends over the metacarpus from the region of the extensor pedis tendon. The articular form is more diffuse; it often covers the sides of the knee, and is firmly attached to the underlying parts. Induration or ossification is denoted by unusual hardness, and by greater difficulty in moving the joint than in the two other forms. Lameness, except in the articular form, is usually slight; only when the disease is acute and causes great pain, or when the swelling becomes excessive, is movement much interfered with.

The treatment of "capped knee" is as varied as its causes, and must depend on the nature of the injury and the anatomical changes. Fresh bruises and acute inflammation, accompanied by great pain, are best combated by cold applications, followed later by warmth and moisture. In skin injuries search must be made for foreign bodies like splinters of glass, fragments of gravel, &c., and the dressings should be saturated with disinfecting fluid; in any case plenty of clean straw must be provided, and it is well to cover the floor of the stall with sawdust or chalk.

Where superficial fluctuation can be detected, cavities should be

opened at the lowest point. The animal is tied up securely, and an assistant directed to grasp it by the nose. The knee is then raised and flexed as much as possible, and the swelling is opened with a bistoury, the knife being directed downwards and outwards to prevent injury to the deeper seated structures. The cavity is freed from clots with the curette, the animal placed on soft, clean straw, and the wound cleansed daily. Recovery generally occurs in three to four weeks. Hertwig recommends passing a seton through the swelling, leaving it in position for fourteen days, and following this treatment by blistering.

Although similar treatment may be employed in the synovial form, it is better, if the parts are already aseptic, to puncture with the trocar, using antiseptic precautions, and afterwards inject a solution of iodine. Should this fail, or should purulent inflammation of the sheath of the tendon set in, it may be necessary to lay the sheath open and thoroughly cleanse it. Having regard, however, to the fact that this form of the disease is frequently of a tuberculous nature, treatment is seldom of much value, and animals should be prepared for the butcher. As a rule, little can be done for the indurated or horny form of capped knee, unless the tumour is small, pendulous, and has not too broad a base, in which case it can be extirpated, but it is difficult to prevent suppuration and excessive growth of granulations after operation. The introduction of euphorbium or caustics like sublimate and acids into the swelling, is liable not only to injure the articulation but to increase the growth.

III.—CHRONIC INFLAMMATION OF THE KNEE-JOINTS.

CHRONIC inflammation of the knee, *arthritis chronica*, occurs oftenest in horses, and has long been recognised. Cherry described it under the title of "knee spavin." Schrader found the articular surface more or less "degenerated," the cartilage worn away, and exostoses on the bones. He also described ulceration of the cartilage of the joint, necrosis and exostoses of the bones, and ankylosis. According to Cherry, the *os lunare* and head of the large metacarpal may alone suffer, but the inflammation generally extends farther.

Causes. Horses with narrow, imperfectly-formed knees, short fore-arms and upright shoulders, appear most predisposed to the condition, possibly on account of the peculiarly exaggerated movement in the knee-joint which such formation favours. Russian trotters display this form and action most conspicuously, and also very frequently suffer from chronic *carpitis*. Cart horses that "dig "

their toes in the ground, and young race horses are often affected. Not infrequently the disease is bilateral ; it is certainly more common in coarse than in well-bred animals, and is favoured by putting young horses to work too soon. Inflammation may extend from the periosteum to the joint, particularly in horses with defective formation, which are thus liable to "brush" in going, as is often the case in Russian trotters.

Symptoms. Swelling is the chief symptom, and is sometimes so great that the entire knee may appear involved. The swelling is usually hard and firm, consisting principally of new connective tissue and later exostoses, but when the sheaths of the tendons are involved, and become distended, it is soft and fluctuating. Free movement of the joint is often interfered with. When resting, the animals lean forward, and if forced to move go stiffly. Bending the knee either produces pain or is attended with difficulty.

Lameness may be well marked, or hardly noticeable. It occurs oftener than is believed, and is shown by the limb being advanced more slowly and the stride shortened, whilst the knee-joint is imperfectly flexed and the limb abducted when weight is placed on it. If both limbs be affected, or if the process be confined to the lower portion of the joint, which in the horse is only slightly movable, there may be no lameness. According to Cherry, such a horse gives the rider the feeling that the thorax is pressed out of position and rises with every stride. The condition is most liable to be mistaken for navicular disease. The limb is extended, and turned slightly outwards. The quarters of the foot often reach the ground first, and on account of the peculiar gait the condition was in England termed "chest founder." The pace naturally assumed is a short, unpleasant trot, which shakes the rider. The forward stride of the diseased limb is shortened, giving a certain resemblance to shoulder lameness. The difference consists in—

- (a) The circular sweep of the limb when moved forward.
- (b) In the horse bringing the quarter of the hoof to the ground first.
- (c) In the production of pain by forcibly flexing the joint.

Course. The nature of the disease explains why it is so often chronic or incurable. The most favourable cases last from four to six months, and it is therefore of great importance to know whether or not the horse will afterwards be useful. The smaller the exostoses, and the lower they are situated, the more favourable the prognosis. The disease is, of course, not so serious in heavy working-horses as in hacks.

Treatment. Treatment is principally confined to blistering or the use of the actual cautery, and though frequently ineffective, sometimes decreases the lameness in two or three months. In young horses rest alone may result in recovery. Where the growths arise from the periosteum of the metacarpus the pointed cautery is of use. Division of the median nerve sometimes removes the lameness; Möller so far cured several cases by neurectomy that the animals became perfectly useful even for carriage work.

IV.—DISTENSION OF ARTICULAR AND TENDINOUS SYNOVIAL CAVITIES IN THE FORE LIMB.

IN the fore-limb several of the joint cavities and tendon sheaths are so situate that distension is not visible externally. This is the case in the shoulder and elbow. But in the knee, fetlock and pastern joints, tendon sheaths and bursæ, when distended with synovia, form swellings or “galls.” To prevent repetition the most important will here be collectively dealt with. We may distinguish three varieties :— (A) Distension of joints ; (B) Distension of the sheaths of flexor tendons ; (C) Distension of the sheaths or bursæ of extensor tendons.

(A) Distension of articular synovial sacs.

1. Of the knee. Though the construction of the knee is unfavourable to the production of “galls,” yet in working-horses distension of the capsular ligament lying between the radius and upper row of carpal bones is occasionally seen. This constitutes a knee gall, and either appears as a roundish swelling, divided into several parts by the extensor tendons on the front of the knee, or occasionally as a tumour the size of a hen’s egg, lying on the outer surface of the limb, behind the radius and just over the pisiform bone.

2. Of the fetlock (articular wind galls). These consist of roundish swellings between the metacarpus and suspensory ligament, caused by distension of the synovial membrane of the fetlock-joint. They often appear divided into two parts, are seldom larger than a duck’s egg, and extend forwards on either side of the fetlock. When the foot is lifted they may disappear, but immediately weight is placed on the limb they return. Hoffmann says they are particularly noticeable when the fetlock is upright.

3. Of the foot. These are of rare occurrence. They appear above the coronary margin at the toe as tense, slightly painful swellings ; their real nature is often unrecognised. Frick has seen

a number, and has satisfied himself of their true character by post-mortem examination.

(B) Distension of the sheaths of flexor tendons.

It is now generally allowed that distension of the sheaths of flexors calls for greater care in treatment than that of extensors. The first variety may be divided as follows:—

1. Knee gall. In the carpal arch at the back of the knee, the flexor tendons have a large sheath which begins about 2 inches above the carpus and extends to near the middle of the metacarpus (Fig. 471, *c*). Eichbaum says that above and below the joint its lateral walls are unprovided with fibrous strengthening coats, and thus explains why the swelling appears above and below the knee, and frequently on the inner, sometimes on the outer side. The enlargement may become excessive, but generally takes the form of a longish, soft swelling, the outline of which corresponds with the borders of the sheath. When the limb is lifted, the communication between the upper and lower portions of the swelling is easily detected by palpation.

2. Tendinous wind galls. The above-described tendon sheath only extends as far as the middle third of the metacarpus, the next portion of the flexor tendons being surrounded by loose connective tissue. At the lower third the great sesamoid sheath begins and extends downwards behind the fetlock-joint to the centre of the coronet bone (Fig. 471, *d*), where it is separated from the navicular sheath by an attachment of the perforans tendon. It lines the fetlock aponeurosis and sesamoid pulley and is reflected on the flexor tendons. Below the fetlock a fibrous expansion surrounds it so firmly that distension usually only occurs above the fetlock-joint, and (on account of the position of the flexor tendons) on either side. At this point the sheath is covered with loose connective tissue, which favours the production of the two characteristic longish swellings lying on either side of the lower end of the metacarpus, close to the flexor tendons and extending upwards on the cannon bone. Their



FIG. 470.—Distension of the extensor pedis and flexor sheaths. After a photograph.

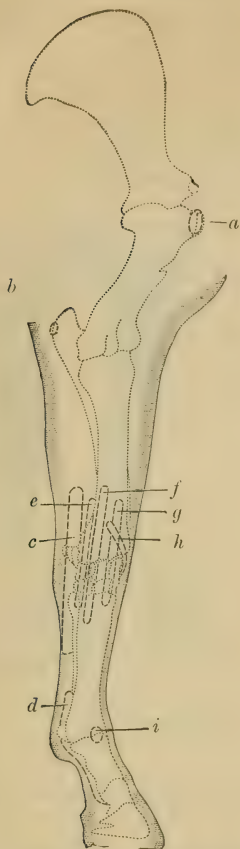


FIG. 471.—Schema of the more important tendon sheaths and bursæ of the fore limb, seen from in front and without. *a*, Bursa intertubercularis; *b*, bursa olecrani; *c*, upper tendon sheath of the flexor pedis muscles (carpal sheath); *d*, lower tendon sheaths of the flexor pedis muscles (metacarpo-phalangeal or great sesamoid sheath); *e*, sheath of the flexor metacarpi externus; *f*, upper sheath of extensor pedis; *g*, sheath of extensor metacarpi magnus; *h*, sheath of extensor metacarpi obliquus; *i*, bursa of extensor pedis.

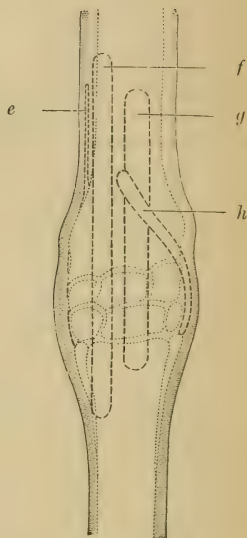


FIG. 472.—The same, as seen from the front.

size varies greatly; sometimes they can only just be detected, sometimes they are as large as a goose's egg. Occasionally they appear below the fetlock at the back of the pastern, and are then of a more flattened form. Wind galls are very common. They generally result from chronic synovitis, and are often found indurated in old horses.

(C) Distension of the sheath or bursæ of extensor tendons. The most important are:—

(1) Distension of the sheath of the extensor suffraginis. This consists of an elongated swelling beginning at the lower end of the radius, on the outside of the knee, and extending downwards; in some cases it may even encroach on the front of the joint (Fig. 473, c).

(2) Distension of the sheaths of the extensor tendons in front of the carpal joint.

(a) The sheath of the extensor pedis, which begins above the knee-joint, passes through the outer furrow in the lower end of the radius, and over the front of the carpus as far as the upper end of the metacarpus (Figs. 471 and 472, f). On account of its being clothed in a strong fascia, dropsy of this sheath seldom occurs.

(b) The sheath of the extensor metacarpi magnus begins at about the same height; and extends through the middle furrow in front of the radius as far as the lower row of carpal bones (Figs. 471 and 472 g, 473 a).

(c) The tendon of the oblique extensor of the metacarpus is provided with a small sheath or bursa in the groove at the lower end of the radius. Distension of this bursa produces a sausage-shaped swelling extending obliquely towards the inner small metacarpal bone (Figs. 472 h; 474 a).

(d) At the front of the fetlock the tendons of the extensors pedis and suffraginis are each provided with a bursa. The bursa of the extensor pedis sometimes communicates with the fetlock-joint. Distension may result in the formation of a very large, sometimes bilobular, almost painless swelling in front of the fetlock.

Causes. In the horse, these swellings are, with few exceptions, produced by chronic irritation caused by severe continued work, leading to dropsy of the joints or tendon sheaths, and are, therefore, almost always confined to working-horses.

A predisposition to them, depending on individual peculiarities which are not infrequently inherited, exists in certain horses. The cause is clearly some defect in the tissue, though its character is not yet clearly understood. The commonest causes are of a mechanical nature, such as strains, partial rupture of tendons or

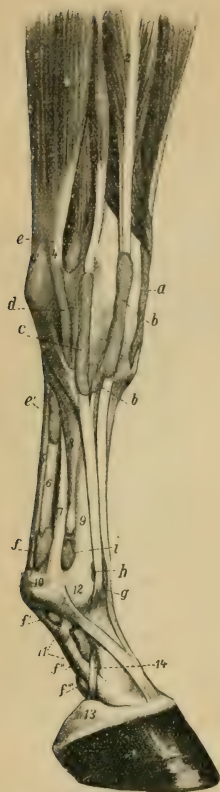


FIG. 473.—Outer surface of the fore limb ; to show synovial sheaths. *a*, Tendon sheath of extensor metacarpi magnus ; *b*, tendon sheath of extensor pedis ; *c*, tendon sheath of extensor suffraginis ; *d*, tendon sheath of flexor metacarpi externus ; *e* *e'*, superior and inferior pouches of the synovial membrane of the carpal sheath ; *f*, *f'*, *f''*, and *f'''*, superior, middle and inferior pouches of the synovial membrane of the metacarpo-phalangeal sheath ; *g*, bursa beneath the extensor pedis tendon ; *h*, bursa beneath the extensor suffraginis tendon ; *i*, protrusion of the synovial capsule of the fetlock-joint.



FIG. 474.—Inner surface of the fore limb ; to show synovial sheaths. *a*, Tendon sheath of the extensor metacarpi obliquus ; *b*, tendon sheath of flexor metacarpi internus ; *c*, carpal sheath ; *d*, *d'*, *d''*, *d'''*, superior, middle, and inferior pouches of the metacarpo-phalangeal (great sesamoid) sheath ; *e*, bursa beneath the extensor pedis tendon in front of the fetlock ; *f*, distended synovial capsule of the fetlock-joint.

tendon sheaths or wrenching of joints. The synovial membrane becomes inflamed or blood is poured into its cavity. In exceptional cases, external influences, like displacement or contusion of the joint, occasion enlargements of bursal cavities. Thus, bruising may be followed by bleeding into the capsule of the joint or tendon sheath, and years after the accident, flakes of fibrin may be found in the joint or tendon sheath.

Symptoms. The symptoms need scarcely be enumerated after what has gone before; and if the anatomy of the parts is borne in mind, diagnosis presents no difficulty. Bursal enlargements, both of the knee- and fetlock- joints, diminish, however, when the limb is relieved of weight or is flexed, whilst those of tendon sheaths become more distinct and appear more tensely filled. Swellings due to distension of articular sacs are generally horizontal, those of tendon sheaths more or less vertical. The presence of acute inflammation is shown by heat, swelling, and lameness.

Prognosis and course. Chronic dropsy of the synovial cavities of joints and tendons results in the horse from chronic irritation; in occasional instances from acute inflammation; bursitis of the sheaths of the extensor tendons is generally accompanied by lameness. Enlargements of the upper sheath of the extensor suffraginis often contain fibrinous clots—a result of their hæmorrhagic origin—even after having been in existence for some time. On the other hand, enlargements developing either from joints or from flexor tendon sheaths are, with few exceptions, due to chronic irritation of the synovial membrane. Sometimes the cavity is filled with light-coloured, clear serum; less frequently it contains small bodies resembling grains of rice; occasionally the tendon sheath is more or less thickened (*tendovaginitis chronica fibrosa*; indurated galls). In such case the tendon may be involved.

For the most part, such enlargements in horses are only regarded as blemishes, and in old animals are seldom entirely absent. When of fresh growth and small size, they may, if properly treated, be cured; but, on the other hand, may persist for long, and resist all forms of treatment, yet without impairing the animal's usefulness.

Distensions of the extensor sheaths may cause lameness, but are more accessible to operative interference, and are, therefore, of less moment than flexor distensions. Chronic distension of flexor sheaths, especially when near joints, is more difficult to remove, still more so are distensions of capsular ligaments.

Galls on the flexor tendons, particularly in the hind limbs, are apt to become chronic and indurated. They are even more trouble-

some if accompanied by inflammation of tendon and by lameness, complications which are also more frequent in hind than in fore limbs. As a rule, the swelling appears distinctly above the sesamoid bones.

Treatment must follow general principles, and it is here only necessary to remark that recent painful conditions are best treated by cold douches, or by immersing the parts in cold water. This should, when possible, be supplemented by bandaging and compression. As soon as inflammation subsides, moist warm applications may replace the cold ones, compression being continued and, if the parts are not painful, massage may be tried. Light work also promotes absorption. Though moderate recent swellings may sometimes be dispersed in this way, the effect is seldom permanent, for distension generally recurs with work, and the practitioner is forced to resort to irritants like cantharides ointment, ungt. hydrarg. biniodid. 1: 8, sublimate, &c., or, better still, to blistering-plaster, cantharides collodion, or the firing-iron. The effect of these applications is to be ascribed to the regular and lasting pressure produced by the swelling acting on tendon sheaths or capsules of joints, and assisting absorption. On account of the pressure it exercises, blistering-plaster acts more energetically than blistering ointment. The firing-iron produces its effect by cicatricial contraction. When freely used it is most effective, though, as it leaves scars, and only substitutes one blemish for another, it should not be lightly resorted to; nevertheless it is one of the most valuable remedies in such cases.

The effect of artificial drainage has been much overstated. In France, however, drainage and the subsequent injection of iodine solution, has long been a favourite method of treating chronically distended synovial cavities. Simple evacuation by trocar is in nowise dangerous if performed with aseptic precautions, but its effect is not lasting, and the tendon sheath or joint refills in a few hours, though, after repeated abstraction of fluid further distension may be stopped. Cure is always uncertain, and even the after-injection of iodine does not ensure it. Sometimes the tendon sheath undergoes gradual thickening and its contents become absorbed, success or failure appearing particularly to depend on the degree of inflammation produced by the injection. It is best to use a freshly-prepared solution of iodine, to see that it is removed after injection, and to follow this with a blister or with firing; when blistering is contra-indicated, a tight bandage may be substituted. To test the relative danger of iodine injections, Leblanc and Thierry made a series of

thirty-two ;—fifteen into joints, seven into mucous bursæ and ten into tendon sheaths, without in any case having bad results. Needless to say, they observed full aseptic precautions. In general, this treatment is uncertain, and when the distension is indurated, impracticable. Masses of fibrin can only be removed by incision, and although in theory such operation should not be dangerous if performed aseptically, yet there is no certainty that dressings will remain in position ; and even when the preliminary dressing, applied for the purpose of sterilising the parts, has not been interfered with, dressings applied after operation are often violently rubbed off. The same is true in regard to animals other than the horse. The opening of distended joints or flexor tendon sheaths is in general dangerous, though there seems no particular risk in opening extensor sheaths, even when the parts cannot be kept aseptic. The risk need not prevent operation being tried, but attention should certainly be previously directed to the danger, and asepsis should be observed. With this object, twenty-four hours beforehand, the hair is shaved from the point of operation, the skin washed, and a dressing moistened with 1 per 1,000 of sublimate applied. After casting the horse for operation and removing the dressing an incision is made, at the most prominent point of the swelling ; the finger is then introduced, the condition of the sheath examined, and any masses of fibrin, &c., removed. The cavity is washed out with a solution of iodine and iodide of potassium in water (1 : 3 : 16), followed by sublimate or carbolic solution. The loose distended skin can then be partly cut away in an elliptical form, the wound closed with silk, and a protective dressing applied to exercise light pressure. This dressing should not be changed for about eight days. The wound probably closes in three to four days, though the cicatrix is not then sufficiently firm to prevent re-opening if the animal be moved. Operating in this way Ries cured a large wind gall (enlarged sesamoid sheath) and an enlargement of the precarpal sheath of the extensor pedis tendon which had resisted all ordinary methods of treatment. In distension of the extensor sheaths gauze drains may be used, but Möller prefers operation.

Bosco has recommended opening enlarged tendon sheaths with the red-hot iron, and favourable results have since been announced by other operators. The glowing point of a fine firing-iron is thrust into the enlargement, allowing its contents to be discharged. More or less severe inflammation results, and recovery may possibly follow. As the point of operation itself is sterilised and an aseptic wound produced which soon closes by inflammatory swelling,

opening by the actual cautery is less dangerous than by the knife, but the effect is not always reliable. When the exact degree of inflammation necessary to prevent after-secretion of fluid is produced, a cure may result, but this degree is very difficult—indeed, usually impossible—to secure at will.

The same criticism applies to drainage of synovial sacs. This treatment consists in puncturing the distension at the highest point, passing a director and making a counter-opening at the lowest point inserting a drainage-tube, and irrigating the sac with 1 in 1,000 sublimate solution. Active inflammation follows and persists for three or four weeks. In favourable cases, the endothelial lining of the sac, though at first replaced by granulations, is said to be restored. The treatment has hitherto been confined to enlargements of the extensor sheaths in front of the knee and fetlock.

To sum up : enlarged synovial cavities should at first be treated by rest, cold applications, massage and compression. If they cause lameness a blister can be tried ; in the event of this failing the parts are fired in lines or points, or the swelling may be punctured with the cautery and the contents evacuated, but only with full antiseptic precautions. For enlargements of old standing which resist other forms of treatment and cause permanent lameness neurectomy may be performed.

Frequently in hunters and steeple-chase horses, occasionally in others, tendon sheaths are punctured by thorns, or opened by wire, nails, splinters, &c. Acute synovitis, often complicated by suppuration, follows, and a very serious wound results. Under treatment usually the wound heals, leaving considerable permanent distension or thickening of the sheath. Sometimes healing is retarded or prevented by the presence of a foreign body, which may be difficult to discover or remove, or the wound may close and after an interval further swelling and pus formation occur near the seat of the primary injury. In most cases counter-openings have to be made for the free discharge of exudate or pus and to permit of thorough disinfection of the sheath. Sometimes thorns penetrate the sheaths and remain permanently without inducing important symptoms. The sheath may be somewhat distended and painful, but the irritation gradually subsides and the thorn may only be revealed, months or years later, by post-mortem examination. Thorns—sometimes as many as forty—have been found lodged in sheaths and beneath the aponeuroses of the limbs of horses which during life exhibited no symptoms of lameness attributable to this cause.

V.—INFLAMMATION OF THE SYNOVIAL SHEATH OF THE CARPAL ARCH. THOROUGHPIN OF THE KNEE.

THE synovial investment of the carpal arch and flexors of the foot, lying at the back of the knee, may become inflamed. For the arrangement of this sheath see under "Rupture of the Flexor Tendons." Acute is commoner than chronic inflammation, and is caused by bruises or wounds. The sheath may be opened by the horse putting its foot into the manger, or by a stab with a fork or other sharp instrument. Sometimes cellular inflammation extends from the metacarpus to this point; septic inflammation following tenotomy is most dangerous. The chronic form generally starts from the check ligament of the perforans, and often produces distension of this sheath, extending some distance above the knee-joint. As a rule, the swelling appears on the inner side of the joint, both above and below, but in the latter situation may involve the outside. Palpation reveals the connection between the different parts.

Whilst, then, the chronic form appears as a fluctuating swelling in the carpal arch and over the flexor tendons, and is accompanied by little lameness or pain, the acute open variety shows the following symptoms:—

(1) Marked lameness; the limb is held stiffly, and is incompletely flexed.

(2) Increased warmth; pain on pressure; more or less firm, hard swelling, which surrounds the entire joint, and extends for some distance beyond it. In purulent inflammation, periarticular abscesses may form.

(3) Discharge from the wound of large quantities of synovia, afterwards mixed with pus, sometimes with necrotic fibres of the tendon sheath.

(4) Usually fever; in septic cases, the temperature may be very high.

Course. The acute open form generally takes an unfavourable course, and when caused by extension of infective cellulitis or by punctured wounds, is always dangerous; little can then be done, and slaughter is advisable. The appearance of fever is, therefore, always threatening. Simple inflammation is less serious, and recovery commonly occurs, though some swelling may be left. Though more difficult to treat, the chronic form, associated with formation of large swellings, does not as a rule interfere with the animal's working powers.

Treatment. In the chronic form blisters or firing may be tried, but are rarely successful. Nor is compression or massage of much service. If thought desirable, bandages may be firmly applied extending above and below the joint, and changed from time to time. Better results, however, attend the injection of weak iodine, sublimate or carbolic solution after the synovial sac has been emptied with a fine trocar or aspirating needle. When the sheath is wounded, every effort must be made to render the parts aseptic, and after inserting sutures, a dressing must be applied. In purulent synovitis, the bursa may be frequently rinsed out with antiseptics, though such treatment is seldom successful. The horse must, of course, be slung. Where an antiseptic dressing cannot be applied, the parts may be permanently irrigated with boiled water or antiseptics. If performed cautiously, there is little danger in puncturing the swelling and giving exit to contents, though the gain is slight, but particular care should be taken not to make large incisions, unless they can be kept aseptic, as purulent synovitis generally results, and frequently proves incurable.

D. DISEASES OF THE METACARPUS.

The metacarpus in solipeds consists of the cannon bone, and the two small metacarpals. The tendons of the extensors of the digit cover its anterior surface; behind it lie the suspensory ligament and the two flexor tendons, to some extent enclosed by the two small metacarpals. The whole metacarpus is covered with a tensely-stretched skin, which is only slightly movable on the underlying parts.

In ruminants the two cannon bones become united soon after birth and form only one bone, on whose posterior and outer surface lies the rudimentary small metacarpal, which is articulated to the fused metacarpal by means of a small joint. This rudimentary metacarpal does not contribute to the formation of the knee.

In swine the two middle or true cannon bones form, with the external or false metacarpals, the metacarpus. Carnivorous animals possess five metacarpals, those of the third and fourth toes being the strongest.

I.—FRACTURES OF THE METACARPUS.

In solipeds fracture often involves the three bones of the metacarpus. The small metacarpals seldom escape, still less frequently are they alone fractured. In other animals, particularly in carnivora, a single bone may be injured, though it is more common for several to be broken at one time. Owing to the thin covering of soft parts the closely-applied skin is readily perforated by fragments; compound fractures are thus produced, which unite with great difficulty.

Causes. The most frequent causes are kicks, falls, and in small animals, blows with heavy sticks, and injuries from carriages. Sometimes in the horse the large metacarpals of both limbs are suddenly and unaccountably fractured while the horse is cantering at a slow pace on grass.

Diagnosis is seldom difficult, the abnormal mobility of the parts, the inability to place weight on the leg, and the crepitation pointing clearly to fracture. It becomes, however, more difficult where single bones are involved, but even then careful palpation is generally sufficient, and crepitation can almost always be detected. Fissuring of the cannon bone can seldom be more than guessed at. Such cases have, however, been reported. Like similar accidents in connection with the pastern and tibia, fissuring of the cannon bone is apt to culminate, a few days later, in complete fracture.

Course. In most metacarpal fractures recovery is possible, and in small animals is fairly rapid. Compound fracture of the cannon bone, is, however, seldom hopeful, and in the large domestic animals even subcutaneous fracture must be viewed as relatively incurable. Only in colts or valuable and quiet horses is treatment worth attempting, but that complete usefulness may be regained is shown by many reported cases. The course of fracture of the metacarpus chiefly depends on whether the animal can bear its whole weight sufficiently long on the other foot without producing laminitis and descent of the fetlock or os pedis. Union is readier in cattle than in horses, and in them the lameness occasionally left causes no inconvenience. In the small ruminants and in carnivora subcutaneous fractures unite in three to six weeks. Fractures of the diaphyses of the metacarpal bones unite more easily than those in the neighbourhood of joints.

Treatment. Reduction is seldom difficult. Before applying a dressing care must be taken to bring the limb into a proper position, and especial attention should be given to the position of the hoof or claws. In the horse the toe of the hoof, in the ox the interdigital space, is the best guide. A plaster bandage is very useful, especially in small animals.

Stolz employed an ointment, now named after him, composed of two parts of resin and one of wax, which is smeared on linen, and used as a first dressing, over which a splint is applied. Horses must generally be slung. Pujos saw transverse fracture of the cannon bone, just above the fetlock, in the horse, which united after applying a plaster bandage. Eight days (?) after the accident the animal began to place weight on the limb. Forty-five days later, when the

bandage was removed, the limb could be moved as usual. In sixty-six days the horse was again put to work. Permanent deformity of the fractured part is unavoidable.

II.—WOUNDS AND BRUISES OF THE METACARPUS.

ON account of the skin being firmly united to the underlying structures, wounds in this region, especially in large animals, often take an unfavourable course. It sometimes happens that bones, tendons, and tendon sheaths are all simultaneously injured, and such cases demand the most careful antiseptic treatment. The hair should be removed, along with any foreign bodies or loose shreds of connective tissue, and the wound and its neighbourhood carefully washed with a disinfectant. If possible the parts should be immersed in a bath of sublimate, or carbolic solution, and the wound irrigated with a powerful stream of sublimate until its edges are thoroughly saturated with the solution. Gaping wounds must be sutured with aseptic material, and a dressing applied over all. To complete the disinfection it is well for some time to moisten the dressing two or three times daily with an antiseptic.

Immediately the dressing appears soaked with discharge or blood it should be changed, under antiseptic precautions. Thus treated the wound may unite by primary intention, even when tendons, tendon sheaths, or bones are damaged, as shown by reported cases. Similar precautions are required in all injuries complicated with much loss of skin, or where large flaps are threatened with necrosis. In such wounds, cicatrisation is difficult, for in consequence of its firm structure and fixed position the skin cannot stretch; and even when the defect is filled up, the epidermis is not replaced. Exuberant granulations, liable to result after lacerations, must be repressed by the early use of astringents (iodoform conjoined with tannin, dried alum), or by applying a well-fitting pressure dressing, or they may be checked by caustics. In all cases the skin must, as far as possible, be preserved, necrosis prevented by antiseptic dressing, and the fact borne in mind that wounds which fail to heal by first intention always produce well-marked cicatrices.

In horses, the tendons and tendon sheaths in the metacarpal and metatarsal regions are often injured, either by the horse lashing out, or by its falling on sharp objects like broken bottles, scrap iron, sickles, or scythes, by over-reaching in galloping or jumping, or a blow from the foot of a following horse. The flexor tendons are oftenest injured, the extensor pedis less frequently; wounds of the

latter are seldom serious, and heal when treated on general principles. Injuries to the flexor tendons are, however, very dangerous.

There is no difficulty in diagnosis, though it is not always easy to discover the exact extent of the wound. Blood-vessels and nerves may be divided, and bleeding usually demands first attention. The degree of lameness varies. When the flexor pedis perforatus, which is most exposed, is alone divided, it may only be slight, and weight may be placed on the limb, though the fetlock is directed somewhat forwards. Division of the flexor pedis perforans results in elevation of the toe and excessive dorsal flexion of the fetlock on every attempt to stand on the limb. When the flexor tendons and suspensory ligament are cut through the fetlock comes in contact with the ground.

After cessation of bleeding, the divided ends of the tendons may be seen in the wound, and the extent of injury be determined by palpation or by probing with the finger. Sometimes both tendons are lacerated or partially divided, and frequently the perforatus is severed and the perforans bruised. The position of the wound generally indicates whether the sheath of the tendons has also been opened or injured.

Bruises of the metacarpus most frequently occur just below the knee, and may lead to extravasation of blood or lymph. The swelling varies in size, between a pigeon's and a hen's egg, is fluctuating, but not often acutely inflamed, and seldom causes lameness.

Course. Healing chiefly depends on the parts being kept aseptic. When this is possible, wounds heal in two or three weeks, though if pus formation occur they may take four to six weeks, or even months. Injuries confined to the flexor pedis perforatus naturally heal more readily than those affecting both the flexors. Wounds involving the flexor sheaths are exceedingly dangerous, purulent tendovaginitis being common, especially in horses, and therefore, wounds close above the fetlock or in the pastern region are more dangerous than those in the middle of the metacarpus, where posteriorly the sheath is wanting. In the ox the conditions are similar to those in horses, though healing sometimes occurs without any particular precautions. Gerlach saw complete division of the flexor pedis perforans and perforatus in the cow, followed by cicatrisation in four weeks. For some time there was very marked dorsal flexion, but this disappeared in three months. In small animals injuries of this class generally do better, because the limb can be better protected.

Swelling due to bruising is usually indolent and persists for long periods. This is particularly true of bruising over the head of the

internal small metacarpal bone, where a subcutaneous hæmatoma is often produced.

Treatment. Recent wounds require the strictest antisepsis. In many cases, unfortunately, they are already infected by the wounding agent, or by the bandages applied to check bleeding, but can generally be efficiently disinfected, even twelve to twenty-four hours after injury. Bleeding must be checked by styptics, torsion, or by ligature. The limb must then be carefully washed with soap and water, the wound and its surroundings rinsed with sublimate or carbolic solution, all foreign bodies removed, and the wound douched with a powerful stream of antiseptic fluid. If asepsis seems possible, the wound, and even the ends of the tendon, should be sutured, and an antiseptic dressing applied, and renewed as may be required. Provided it is not sodden with blood or wound discharge, the dressing is left in position until the animal begins to place weight on the limb, or the wound is healed.

Failing asepsis, necrotic portions of tendon must be excised, and excessive proliferation of tissue around the wound checked by moderate compression. Necrotic portions already partially separated can be removed with the scissors or knife. Over-prominent granulations may be checked by astringents, such as tannoform, tannin mixed with iodoform, or by dried alum in powder; a well-fitting pressure dressing serves the same purpose. Sometimes new growths may require to be removed with the knife or cautery. All such surgical wounds must be kept very clean to prevent infection. During treatment the patient should be rested in slings.

Where the tendon sheath is also injured, extreme attention must be given to antiseptic precautions. Exudate or pus is apt to distend the lower portion of the sheath, and drainage must be provided by a counter-opening. Reported cases show that careful antisepsis may secure healing even in severe injuries of tendons and tendon sheaths.

Bruising of the metacarpus, due to "speedy cutting," kicks, &c., often causes formation of hæmatoma or hygroma of the size of a walnut, or hen's egg. If soon opened troublesome bleeding may result; on the other hand, absorption takes a long time, particularly in injuries about the head of the inner small metacarpal. Lameness is rare, and animals can be worked, whilst reduction of swelling is encouraged by continuous compression and daily massage. If, in valuable horses, operation be attempted, strict antisepsis must be observed, for pus formation may be followed by subfascial cellulitis and troublesome complications.

Bier's treatment. In certain cases of slow-healing wounds and bruises of tendon sheaths, fasciæ, or joints below the elbow or stifle, treatment by Bier's method of inducing passive hyperæmia of the injured part should be tried. Above the wound a linen bandage, or a rubber tube $\frac{3}{4}$ inch in diameter, is applied round the limb and made sufficiently tight to produce venous congestion and swelling of the part below. At first the applications should be restricted to half an hour twice a day, and afterwards gradually extended to four or five hours or longer according to the effect produced. Compression is accompanied by copious discharge of serum from the wound, extension of infection is prevented, and in suitable cases healing is greatly accelerated. This method may be employed in the later treatment of coronary slough, treads, sinus, verrucose dermatitis, canker, and after mutilation of the hoof.

III.—RUPTURE OF THE FLEXOR TENDONS AND SUSPENSORY LIGAMENT.

THE flexor perforans muscle, three times larger than the *perforatus*, arises from the humerus, radius, and ulna, and extends to near the knee where its tendon begins. The tendon passes through the carpal arch to the middle of the cannon, where it is joined by the subcarpal ligament, then downwards to the fetlock, where it passes through the perforatus ring and over the sesamoid pulley. Descending behind the pastern, under the bifid insertion of the *perforatus* and over the coronary glenoid prominence and navicular bone, it is inserted on the semi-lunar crest of the os pedis. Slightly compressed at the knee, it is rounder at the cannon, considerably expanded and flattened at the fetlock, narrowed though still flat behind the suffraginis, at the os coronæ, to which it is loosely attached, it again expands and rapidly attains its greatest breadth at its insertion. In volume it varies little from its origin to the point of junction with the sub-carpal ligament, and below this the increase is hardly noticeable owing to the gradual attenuation of the reinforcing band. At the fetlock the tendon is thicker, and its anterior surface, moulded on the sesamoid pulley, shows some of the characters of fibro-cartilage. Another increase in thickness and firmness occurs at the os coronæ. It appears to be weakest at its terminal expansion which, however, is well supported by the posterior digital ligament.

The sub-carpal or "check" ligament, a direct continuation of the posterior common ligament of the knee, is united at its origin to the anterior fibrous wall of the carpal arch and the suspensory ligament. Descending, it closely embraces the anterior surface of the perforans, which it appears to join at the middle of the cannon. In many instances their fusion is very gradually effected, as some indication of the parts of tendon and ligament can be traced to near the fetlock. The sub-carpal ligament is the strongest portion of the suspensory apparatus of the fetlock.

The *perforatus* or superficial flexor muscle, arising with a portion of the perforans from the humerus, extends to near the knee, where it is

succeeded by tendon. In close contact throughout with the perforans, the tendo-perforatus passes through the carpal arch to near the fetlock, where it forms a sheath-like ring for the perforans, then descending and becoming somewhat broader it terminates by a bifid insertion on the os coronæ. Before entering the carpal arch the perforatus is joined by the radial ligament, which hitherto has attracted little attention outside the dissecting room.

The radial ligament arises from the inner border of the posterior surface of the lower extremity of the radius and extends obliquely downward and outward to join the perforatus tendon. It is a short, rather lax fibrous band, between two and three inches long, about an inch broad, and less than half an inch thick. Recently in Germany and France, cases of lameness have been attributed to strain of this ligament.

The suspensory ligament, arising from the lower row of carpal bones and the head of the cannon, descends between the sub-carpal ligament and metacarpus to near the "buttons" where it bifurcates. Each branch is implanted on the excentric surface of the corresponding sesamoid, and a portion of each band is continued downward and forward to join the extensor pedis tendon. From its origin to the point of bifurcation the suspensory is flattened and closely applied to the cannon, its branches to the sesamoids are rounded, and the extensor bands are flat. It has a covering of connective tissue which attaches it to the cannon and flexor aponeurosis. In structure it differs from the tendons by containing fasciculi of striped muscle and some fat.

Hind limb. Apart from their points of origin and a few other differences, the more important features of the posterior flexors are:—the perforans in the tarsal arch is not accompanied by the perforatus; at the upper metatarsal region it is joined by the tendon of the accessory flexor muscle, and near the middle of the shank by the subtarsal ligament, which though longer is less thick or strong than the sub-carpal ligament. The perforatus has a very short muscular portion, and its tendon, beginning just below the upper third of the tibia, after a winding course, reaches the point of the hock, where it forms a cap which is attached laterally to the summit of the os calcis. Below the hock the perforatus descends the shank, as in the fore limb, to the os coronæ.

Peritendineum. Each tendon has its own covering of connective tissue. This is composed of several laminae, more or less united, closely investing the tendon, continuous inwardly with the interfascicular septa, and connected outwardly, according to the part examined, with the visceral layer of the flexor synovial sheath, the common aponeurosis, or the adjoining tendon or ligament. Between its laminae the vessels and nerves break up to penetrate the interfascicular septa of the tendon.

Aponeurosis. The metacarpo-phalangean or common aponeurosis furnishes a subcutaneous covering to the flexor tendons and subcarpal ligament, and separates these from the suspensory. It consists of two principal layers of fibrous tissue, united to each other and to the tendons or parietal synovial sheath by areolar tissue and continuous with the posterior wall of the carpal arch and fascia of the fore-arm. It forms a strong fibrous brace for the flexor tendons at the sesamoids and pastern, and supports and protects the vessels and nerves. In the hind limb the metatarso-phalangean aponeurosis is similarly arranged.

Synovial sheaths. Facilitate movement of the tendons, and consist

of two parts continuous with each other ; a parietal, lining the aponeurosis or other supporting tissue, and a visceral, investing the proper covering of the tendon. The opposed surfaces are lined with endothelium. The carpo-metacarpal sheath, extending from about two inches above the carpus to near the middle of the cannon, lines the carpal arch, and part of the metacarpal aponeurosis, and is reflected on both tendons in the carpal arch and below on perforans, posterior surface of subcarpal ligament and anterior surface of perforatus tendon. From an inch or two below the carpal arch to the upper margin of the sesamoid sheath the perforatus has no synovial on its posterior surface, and the anterior surface of this portion of the tendon is separated by loose connective tissue from the parietal synovial of the perforans.

The great sesamoid sheath extends from the level of the "buttons" to the middle of the os coronæ, where it is separated from the navicular bursa by an attachment of the perforans. It lines the aponeurosis and sesamoid pulley and is reflected on flexor tendons, being modified at the sesamoids by the absence of endothelium on the anterior surface of the perforans. There is no synovial covering on the portion of the posterior surface of the perforatus which is united to the aponeurosis of the fetlock.

The navicular bursa or sheath extends from middle of os coronæ to below the navicular bone ; it forms a short synovial sac between the perforans and the navicular bone and its interosseous ligament.

Tendon is made up of groups of parallel white fibrils, interspersed with flattened nucleated connective tissue cells, arranged in rows running in the direction of the tendon fibres. Between the bundles are interfascicular spaces, and primary and secondary connective tissue septa, continuous with the peritendinous covering. The nerves (few and non-medullated), blood-vessels, and lymphatics ramify in the septa. The subcarpal and subtarsal ligaments have thicker interfascicular septa and are more vascular than the tendons.

Rupture of the flexor tendons is produced by external violence,

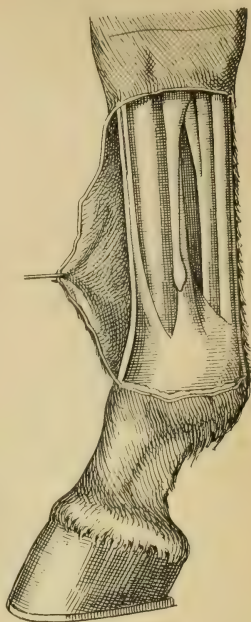


FIG. 475.—Showing relative positions of tendons, &c., in the metacarpal region. Immediately behind the metacarpus lies the suspensory or superior sesamoid ligament ; the short band extending from behind the knee half-way down the metacarpus is the check ligament ; behind it lies the perforans tendon, to which it is connected ; the hindmost of the tendons shown is that of the flexor pedis perforatus muscle.

especially by violent over-extension when weight is thrown on the fore limb; it is therefore almost entirely confined to solipeds, the great strains necessary for its production only occurring during movements like jumping or galloping. In ruminants a ligament, extending from the knee to the claws, assists in preventing such accidents. Rupture is favoured by changes in the nutrition of the tendons, as after neurectomy and infectious disease, and even after long rest rupture may follow slight exertion. Sometimes

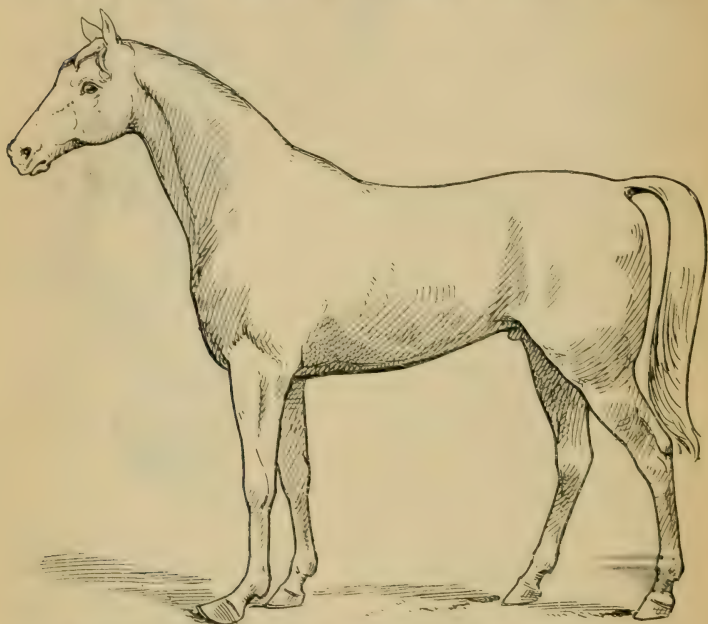


FIG. 476. —Rupture of the flexor pedis perforans and perforatus tendons.

partial or complete section of one or both flexor tendons is produced by the horse "over-reaching" when galloping on holding ground.

Schellhase and Comény saw simultaneous rupture of the inferior sesamoid ligaments of both fore limbs in horses which had been long rested. Johne also observed rupture of this ligament in a foal which had been in hospital, and as the rupture was accompanied by tearing away of portions of bone, suggested it was due to change in the bone substance. In another case the superior sesamoid ligament was ruptured near its bifurcation in a horse which had fallen. Smith describes a case where, in

consequence of the horse jumping, both flexor tendons and the suspensory ligament of one fore limb were suddenly ruptured, the metacarpus penetrating 4 inches into the earth.

Kay noted rupture of both flexor tendons and the suspensory ligament in three separate limbs. The flexor pedis perforans was torn away from the os pedis and the suspensory ligament from the sesamoid bones, while portions of the bones were also loosened. The horse had previously been lame, and for some time incapable of work. In the year 1890 a horse was sent to the Berlin clinique suffering from recent and sudden lameness; the animal could scarcely stand even for a few moments. When forced to do so, the hind feet were placed far forwards and the fore feet disposed as in laminitis. Post-mortem showed rupture of the flexor pedis perforans in all four feet just above its insertion into the os pedis. No exact explanation of the cause could be discovered further than that the horse had previously been confined to the stable for some days on account of lameness in one limb. A similar case was reported a year later; in another the flexor pedis was torn away from the os pedis in both hind limbs, and the sesamoid bones of both front limbs were fractured. In these cases, also, the animals had previously been unworkable. Maillet, in a horse, saw both flexor tendons ruptured. Some old-standing disease, such as partial rupture of the tendons, had probably been in existence. Rodet noted a similar accident, affecting both fore limbs, occur during galloping. Schraml describes tearing away of the flexor pedis perforans from its insertion into the os pedis, portions of which remained adherent to the tendon; the navicular bone was broken into many fragments, which Schraml ascribes to the excessive weight thrown on it after rupture of the tendon. Dégive saw rupture of the flexor pedis perforans in all four limbs after an attack of laminitis.

Möller has repeatedly seen similar cases. The suspensory ligament is almost always torn away from its attachment to the sesamoid bones, whilst portions of the bone are loosened. In van-horses the suspensory ligament is sometimes ruptured, even in the hind limbs. In front, this rupture is commonest in race- and steeple-chase horses, and is generally caused by fast galloping or in jumping. Sometimes the flexor pedis perforans is affected, though the suspensory ligament may also be ruptured. Fig. 478 is drawn from a case of rupture of the suspensory ligament in a race-horse which fell lame on the course and had been unsuccessfully treated for a long time.

A careful inspection of instantaneous photographs of moving horses (like those of Marey or Muybridge) shows that in galloping and in landing from a jump the animal's whole weight rests for an appreciable time on one of the fore limbs. At this moment the fetlock is supported by the contraction of the flexor pedis perforans and perforatus muscles, which are elastic, and by the passive resistance of the suspensory ligament, which is comparatively inelastic. Should, then, the strain thrown on the limb exceed the elastic resistance

of the muscles, either they or their tendons must necessarily yield. One of two results may follow. If the muscles yield, the excess strain falls on the comparatively inelastic suspensory ligament, which may be partially or wholly ruptured. If the tendons yield, a similar result may follow, the flexor tendons and the suspensory ligament then suffering together. A single very violent shock is therefore more likely to affect both the tendons and ligament



FIG. 477.—Rupture of the flexor pedis perforans behind the fetlock in consequence of suppuration in the tendon sheath.

(because the muscles being untired do not yield), while long-continued exertion is favourable to strain of the suspensory ligament alone, on account of the muscles relaxing and the pull on the tendons never becoming sufficient to overcome their tensile strength. In the latter case the excess strain necessarily falls entirely on the suspensory ligament. The fact that strain of the suspensory ligament is nearly confined to the front legs in all riding horses is explained by the fact that an unduly large proportion of the rider's weight falls on the fore limbs, and that this proportion tends to increase with increase in speed.

Rupture of the flexor perforans often coincides with disease of its surface at the point where it passes over the sesamoids or navicular bone, a change which commonly accompanies chronic navicular disease, and which may terminate in partial necrosis of the tendon. Rupture of the flexor perforans and perforatus often follows purulent inflammation of their sheath and of the gliding surface of the sesamoid bones. In such cases rupture is due to inflammation in the sheath of the tendons; it is favoured by neurectomy. Fig. 477 shows an almost complete rupture of the flexor pedis perforans behind the fetlock, consequent on purulent disease of its sheath. During navicular disease the gliding surface of the navicular bone becomes rough and produces erosion of the perforans tendon; the peculiar cases following neurectomy result from over-extension of the tendon, which is in a condition of impaired nutrition.

Möller describes cases where the perforans and perforatus tendons in hind limbs have become totally ruptured on account of advanced necrosis. Septic cellulitis extending to the flexor sheaths sets up purulent tendovaginitis, which leads to necrosis of the tendon. The animal then stands continuously on the other foot, this sometimes causing descent of the pedal bone. Pain then increases to such a degree that weight is placed on the first affected limb in spite of the disease of the tendon. This apparent improvement is, however, suddenly arrested by rupture of the tendon.

Necrosis of the ruptured tendons is indicated by the dull yellow colour of the structures, and (in cases where separation of the dead parts has already set in) by the red granulations bordering the normal tendon tissue.

Gramlich describes a horse which, during the course of influenza, suffered from inflammation of the tendons of all four limbs. In one fore-leg the perforans and perforatus tendons were both ruptured, and on post-mortem examination were found partly necrotic.

Rupture of fasciculi occurs in almost all cases of inflammation of the flexor tendons produced by severe strains.

Symptoms. Rupture of the perforans is at once followed by



FIG. 478.—Rupture of the superior sesamoid or suspensory ligament (from a photograph).

lameness. Either no weight can be borne by the limb, or if weight is placed on it for a moment the affected joint is abnormally flexed; this symptom, however, is less marked in rupture of the perforatus tendon. In consequence of the dorsal flexion of the coronet-joint, the toe of the foot is directed upwards. Rupture of the superior sesamoid ligament produces abnormal dorsal flexion of the fetlock (Fig. 478), but the toe retains its normal position. The same is true of ruptures of the inferior sesamoid ligaments. In rupture of the flexor perforans, all three phalangeal joints show abnormal dorsal flexion, the hoof sometimes only touching the ground at the heels. Unless swelling has become pronounced the rupture may be detected by palpation. The degree of pain varies greatly; usually the animal is very restless.

Course. Ruptures of the flexor tendons, excepting those following neurectomy, unite regularly and completely, provided the ends of the tendon are not too far apart. The extent to which the ends of the tendons are displaced may be estimated from the change in position of the fetlock. Under favourable circumstances, rupture of the flexor perforans or perforatus unites in six weeks, though two to three months may elapse before the animal is fit for use. A race-horse which had suffered rupture of the suspensory ligament, with fracture of a sesamoid, in one fore limb was no better after six weeks. It was killed, and on post-mortem it was found that though union had begun, yet there was no visible callus formation between the displaced fragments of the sesamoid bone.

Ruptures of one branch of the suspensory ligament unite in from six to eight weeks, usually without leaving any lameness. The condition is much more grave when the rupture occurs above the bifurcation of the ligament. In rupture of the tendons following neurectomy or necrosis the prognosis is hopeless.

Treatment of complete ruptures is generally useless, because in the majority of cases it is accompanied by much deformity of the limb, and degenerative changes in the tendons. Even in the most favourable cases where the tendon substance is normal, treatment is confined to bringing the divided parts as near together as possible and fixing them, for which purpose plaster bandages are useful. If the animal be quiet, an iron splint fixed to the heel of a bar shoe and of a curve corresponding to the normal position of the fetlock is useful in rupture of either flexor above the fetlock. After covering the foot with a pad to equalise pressure, the splint is padded and fixed in position by means of circular bandages. Slings are generally necessary when using this apparatus.

Rupture of the extensor tendons is very rare, and is usually brought about by efforts to liberate a foot which has been caught in some obstacle like railway points, or by a direct mechanical injury severing the tendon. Healing is slow, owing to the excessive volar or plantar flexion ("knuckling") which occurs. A suitable iron splint may, however, overcome the difficulty.

IV.—INFLAMMATION OF THE FLEXOR TENDONS (TENDINITIS) AND OF THE SUSPENSORY AND CHECK LIGAMENTS.

INFLAMMATION of the flexor tendons is very frequent in the horse, and generally occurs in the fore limbs, on account of their being much more exposed to the violent strains which form the general cause of the disease.

Causes. Horses with weak flexor tendons, heavy bodies and powerful muscles, are most predisposed to tendinitis. The structure of the tendon, or its power of resisting strain, is of the greatest importance; its absolute thickness bears no direct proportion to its strength. On the contrary, tendons of considerable size and surrounded by abundant paratendineum suffer more frequently than the more sharply defined or those which are firm to the touch. As mentioned under "Rupture of the Flexor Tendons," continued rest seems to lower the resistance against strains. Rupture and inflammation following severe diseases, are, in part at least, to be referred to this fact. Further, all conditions which increase the load on the limb and the strain on the flexor tendons favour tendinitis.

Long, weak, and slender pasterns are especially liable to it. The strain on the tendons is increased by increased length and obliquity of the pasterns. The more slender the fetlock-joint appears when viewed from the side, the greater the mechanical disadvantage to which the tendons are placed. For a similar reason, horses with "tied-in" knees are disposed to tendinitis, this formation being generally accompanied with small size of the fetlock. Further, everything which favours dorsal flexion of the joint increases risk of inflammation of the flexor tendons. Low heels and long toes are therefore apt to cause it. Long toes throw a powerful strain on the flexor tendons during the latter phase of movement, just before the foot is lifted from the ground. The kind of work required of the horse is also important. Thus race-horses and hunters, and horses required to trot at a sharp pace for long periods, are the most general sufferers. Animals with considerable powers of endurance

suffer most. The greater the muscular development of the hind-quarters, the greater the shocks produced in the fore limbs by the violence with which the weight of the body is thrown forward on to them. Spirited animals suffer more than phlegmatic. For similar reasons, cart-horses show strain frequently in the hind limbs. Those which work in two-wheeled carts and have oblique pasterns are specially liable to tendon strain of the hind limbs, particularly when descending hills with heavy loads.

Strains of flexor tendons are produced by the body-weight suddenly falling on the front limbs when the horse is jumped or quickly pulled up (passive strains), or by continued violent action of the flexor muscles (active strains). In the first instance, the flexor perforatus is principally involved, its less length causing it to suffer first from forced dorsal flexion of the phalanx. The flexor perforans is less likely to be injured. The effective length must be reckoned as the distance between the lower insertion and the upper one, and in the perforans and perforatus tendons from the upper insertion of their so-called check ligaments.

Tendinitis produced by excessive muscular action (active sprain) has, with few exceptions, its seat in the flexor perforans, because the muscular head of this tendon is by far the stronger, and its tendon is therefore exposed to the greater strain. But passive strains also occur, as shown by the frequency with which the check ligament, which extends to opposite the middle of the metacarpus, becomes inflamed. With regard to strain of the check ligament, which is particularly common in cart-horses, the remarks made *re* strain of the suspensory ligament in large measure apply. The conditions, however, are not precisely the same, because owing to their respective mechanical arrangements strains do not affect the suspensory and check ligaments in exactly the same way. Judging from their course and attachments, it would appear that while the suspensory ligament is always more or less in tension, the check ligament is frequently entirely relaxed, and that stress, when thrown on it, is liable to be of the nature of a sharp jerk. Such a jerk would follow any miscalculation of distance on the horse's part, as for instance when the animal unexpectedly steps into a hole. Heavy work is another well-recognised cause of strain of the check ligament in cart-horses. In this case the injury is probably inflicted in starting the load. The animal leans forward in the collar, and before actually commencing to pull causes excessive flexion of the fetlock. At this moment the perforans muscle being relaxed a heavy strain is thrown on the check ligament, which may be injured. Closely

similar conditions prevail when the horse is drawing a load up a steep hill. The injury occurs during relaxation of the perforans muscle. In the hind limbs the portions of the flexor pedis perforans tendon which suffer oftenest are those lying just above the fetlock or below the hock.

Bruising causes inflammation of tendons, though the condition more often affects the flexor perforatus, its superficial situation exposing it to injury from kicks, &c. This kind of injury has been repeatedly seen in hunting- and race- horses, where the tendon is struck and sometimes divided by the hind foot of the same side. Inflammation sometimes extends from the tendon sheath or articular surfaces to the flexor tendons; and the form associated with infectious disease, and occurring during convalescence from influenza, always starts in the tendon sheath. Schrader, who carefully described this disease, found that the first sign of inflammation is a peculiar semi-soft swelling just above the fetlock, which extends thence to the perforans and perforatus tendons. One-sixth of all his cases convalescent from influenza showed it, but the disease disappeared again in a few days. Möller has often seen a similar appearance, and looks on such cases as due to secretory metastasis. In convalescents the inflammation sometimes originates in the perforans tendon, particularly when the animals are worked too early. The interference with general nutrition produced during the disease is probably the predisposing cause.

The greater number of cases described as inflammation of the tendons are, doubtless, really due to reparative processes consequent on partial rupture, as shown by their course and termination. The persistence of thickening points to extensive damage, and is therefore unfavourable. This extra deposit appears to be necessary to recovery, but tendons thus thickened never attain their primary strength or condition.

Filariosis of the suspensory and perforatus has been observed in Austria, Russia, and France. The parasite (*Filaria reticulata*) causes the formation of painless nodular enlargements, which may be mistaken for chronic distensions of the ligament or tendon.

Symptoms. Inflammation of the flexor tendons is accompanied by the following symptoms:—

(1) Lameness, which varies according to the position and extent of injury and the tendon involved. Lameness and pain are most marked in strain of the perforans or its check ligament, less marked in strain of the perforatus or its ligament. In strain of the suspensory usually pain and lameness are slight, and when only one division

of this ligament is affected lameness may be absent. Lameness is usually deferred until some hours after the strain.

Lameness is only shown when weight is placed on the limb. Attempts are made to shorten that phase of movement during which the digit is in a position of volar flexion, *i.e.*, is upright and under the body. Neither passive extension nor rotation appear very painful, a fact which distinguishes the disease in question from disease of the joint. The symptoms then are, supporting leg lameness, shortening of the period when the limb is upright, volar flexion of the phalanx, and absence of pain when the limb is rotated.

(2) Local examination detects pain, swelling, and increased warmth, which latter, however, is only felt early in the disease, and even then indistinctly. It is difficult to distinguish pain in the reinforcing band of the flexor perforatus (radial ligament), though it also occasionally suffers. In applying pressure to the tendons, it is important not to be deceived by mere general sensitiveness.

The swelling varies in degree and extent, that accompanying strain of the flexor perforatus or sub-carpal ligament being, in "clean" legs, sometimes visible from a distance, and in other cases only to be detected by palpation. At first it is soft and diffuse; later it becomes harder and sometimes sharply defined. In examining for pain and swelling, the foot is lifted; the reinforcing bands can only be properly examined in this position.

(3) The symptoms enumerated are afterwards followed by apparent shortening of the diseased tendon, continuous volar flexion and upright position of the hoof. This is differentiated from the volar flexion produced by placing weight on the leg, by the fact that it continues even when the animal stands fairly on the limb; the point is at once settled by lifting the other foot. Whilst contraction of the flexor perforans produces volar flexion in all the lower joints, contraction in the flexor perforatus and suspensory ligament only affects the obliquity of the pastern; the hoof remains in its normal position.

In race-horses a large number of fasciculi of the flexor perforans may be ruptured, producing abnormal dorsal flexion of the phalanges and so-called "break-down." This is oftenest seen when both limbs suffer, or when the animal is forced to stand continuously on the diseased limb.

Similar stretching of the flexor tendons is sometimes seen after neurectomy, performed whilst the tendons are inflamed. The ordinary weight of the body may then cause stretching of the tendon, or of the cicatricial tissue newly formed within it. Möller has seen this

after neurectomy of the tibial nerve while the tendons were inflamed.

Course. The strain always occurs suddenly, and the anatomical structure of the tendons explains its subsequent chronic course.

Excessive tension of a tendon causes partial rupture with retraction of fasciculi, laceration of the peritendinous covering and inter-fascicular septa, extravasation, and sero-sanguineous exudation. The exudate fills the interfascicular spaces and distends the areolar septa, the hitherto quiescent tendon cells increase in size



FIG. 479.—Excessive “knuckling” in a horse (from a photograph).

and become active, while the damaged fibres are partially converted into a structureless hyaline pulp. Inflammatory reaction is set up and in the reparative process the breach in the tendon is made good by granulation tissue, which is formed by the agency of the tendon cells and the fibroblasts of the connective tissue adjacent to the lesion. On section the parts display greyish white, sometimes greyish red, masses of connective tissue. In consequence of the formation of new fibrous tissue thickening results, which may lead to shortening of the tendon from cicatricial contraction, whilst the paratendinitis leads to adhesion with neighbouring tissues. The tendon gradually becomes permeated with blood-vessels; ossification has sometimes been seen in inflamed tendons.

Zschokke describes a case in the horse, in which the sesamoid ligaments were ossified. Roloff found the flexor perforatus changed into cartilage.

Knuckling at the fetlock may either be brought about by shortening of tendons, in consequence of their cicatricial contraction, or of contraction of muscles. In the first case, only the lower joints take up the position of volar flexion; when muscles are involved, the knee-joint is also bowed over. All cicatricial tissue, whether in tendons or elsewhere, is inclined to shrink, but excessive contraction is only seen when the limb is rested and entirely relieved of weight. Fig. 479, which is from a photograph, shows to what extent shrinkage may occur. If weight is placed on the limb, even occasionally, it never becomes so excessive. After contraction the fibres of the tendon no longer run in a straight direction, but take a tortuous course.

On account of the peculiar character of the pathological processes, tendinitis varies greatly in course and results. When caused by strain, it is an aseptic process and nearly always produces permanent distension at the seat of injury. Resorption of inflammatory products may occur in eight to fourteen days when the case is favourable, and when rest and early careful treatment are adopted, but in most instances some thickening remains. Though lameness may disappear in three to four weeks, the newly-formed tissue has not the strength of normal tendon, and a point of less resistance results, which explains the frequent relapses. Continuous severe pain points to serious local change, and often causes knuckling; the **prognosis** therefore depends chiefly on the degree of pain. The results of strains of the flexor tendons depend very largely on the region involved; the most serious being those which affect the flexor perforans and its check ligament, in which complete resolution is rare. Next comes the suspensory ligament. Inflammation of the flexor perforatus is less troublesome; the animal's usefulness is not impaired, even though considerable thickening remains. Needless to say, the older the condition the less the chance of recovery; when lameness is of old standing the outlook is bad. In hacks, prognosis is less favourable than in light van-horses. When the joints are much shot-over, tenotomy is sometimes successful, but this depends on whether the flexor tendons are adherent to one another or to their lower sheaths. Adhesion of the flexor perforans to the perforatus is always troublesome, though cure is not entirely out of the question. Tendinitis occurring during infectious disease is more obstinate than inflammation mechanically produced in otherwise sound animals.

Great pain and resistance to treatment point to an infectious origin, though such swellings occasionally disappear after twelve to twenty-four hours, when the sheath of the tendon is only slightly involved. Möller saw a horse in which the affection changed its seat several times in a few days : leaving the hind, it attacked the front limbs, and *vice versâ* (rheumatic teno-vaginitis).

Treatment. The most important point is to stop work ; where possible, absolute rest should be given, and the shoe removed. Fresh cases, due to mechanical injury, are treated during the first twenty-four to forty-eight hours by cold applications, the best form being immersion or irrigation, but after this time little good results from the employment of cold. Moist warmth, supplemented by proper bandaging, is then preferable, and is applied as follows :— After carefully cleansing the foot, two longish rolls of tow rather thicker than a man's thumb are moistened and laid lengthwise on either side of the diseased tendon, close to the metacarpus, and fixed there by a linen or cotton bandage, wetted and applied tightly. Over this a dry woollen bandage is placed, so as to exercise regular pressure on the material below and on the diseased spot ; when available, a piece of rubber tissue or waxed linen may be placed between the two bandages. Some practitioners envelop the limb thickly in cotton-wool, over which a calico bandage is tightly applied. This dressing is changed every four hours ; the moist warmth and regular pressure favour reparative changes ; excessive extravasation and cellular proliferation are checked and resorption assisted. The rolls of tow or cotton-wool should exercise even pressure on the diseased tendon.

When pain disappears massage may be resorted to during the interval of changing the dressing, the injured tendon being rubbed from below upwards with the thumb and fore-finger, using moderate pressure, for about five minutes at a time, the parts being meanwhile covered with a piece of linen. The operation must not be persevered with if pain or swelling follow. When early and carefully used, massage cures and removes the swelling in cases where, with the antiphlogistic methods formerly employed, thickening almost always remained. The slight vascularity of tendons in no way supports the theory of the action of cold ; on the other hand moist warmth and methodical compression assist absorption, and are certainly not so likely to impede repair as cold. Experience shows this treatment to be by far the best.

Infriiction with ointments or fluids acts like massage, though the specific resolvent effect ascribed to preparations of mercury and

iodine causes them to be most widely used. A mixture of unguentum hydrargyri and sapo viridis in equal quantities can be used, with double the amount of lanoline where massage seems called for. Warm baths of soap or weak potash solution considerably assist absorption.

The action of blisters is largely due to the mechanical effect of infriktion and the pressure of the cutaneous thickening on the inflamed spot ; and when the above-described treatment proves impracticable, it is good practice to apply a blister, or better still, a blistering plaster. The use of "charges," though now almost discontinued, is of considerable value in many cases of strained tendons. Roborans plaster, liquefied by heat, is spread thinly over linen strips and applied with gentle pressure from the fetlock to within an inch or two of the flexure of the knee. Occasionally the liquid plaster is applied to the skin and is covered with finely chopped tow ; but the former method is the better. The charge is left on for six to eight weeks, provided no complications ensue. This method is less likely to blemish than the use of blisters. Pötting assists the action of the blister by a pressure dressing. About the third day, when exudation has ceased, he applies moist wadding to either side of the diseased tendon and passes a woollen bandage over all. The first dressing remains on for two days, and is then renewed and left in place for three to five days.

For perforatus strain, Joly advises peritendinous insufflation of filtered air, followed by massage. This treatment is carried out, with due regard to antiseptic precautions, in the standing or recumbent position. A tourniquet is applied to the fore-arm. The air drawn through iodoform gauze is slowly injected by means of a Potain's aspirator furnished with a fine needle, which is pushed into the subcutaneous tissues over the distension on the posterior line of the leg. When the air has penetrated the healthy, œdematous or indurated tissues of the strained part, the needle is withdrawn and the puncture closed with collodion. Next day the insufflated region should be gently kneaded to drive the air, which tends to spread excentrically, into the meshes of the inflamed tissues. Massage is repeated morning and evening at the most distended parts and finally the leg is douched with cold water. By this method, Joly states, that the effects of peritendinitis are rapidly and radically reduced, and that the indurated centre of tendinitis is quickly isolated and often reduced as well. In 15 days, in certain cases, the tendon has become perfectly cool, clean, insensitive, and resistant to the effects of work.

Old thickenings are best treated by firing. In this case the chief effect is produced by the mechanical action of the inflammatory swelling and cicatricial shrinkage in the cutis. The lines, running obliquely from the front downwards and backwards, should not be wider apart than half an inch, nor should they cross at the back of the perforatus tendon. After the scab has fallen, the above-described pressure dressing can be again applied.

If, in old thickening of the tendons, firing is out of the question, a compress dressing saturated with "water glass" solution is useful, especially in small swellings, and where the animal cannot be rested, but precautions must be taken against dirt or sand getting under it and causing chafing.

The animals must be kept from heavy work for some time, but can be put to exercise as soon as lameness has quite disappeared. During this stage riding-horses must be kept from jumping and continued rapid trotting, nor should they ever be suddenly pulled up.

In shoeing horses with disease of the perforans, the heels should be spared, the toe shortened as much as possible, and shoes with calkins or thick heels used. For many years it has been disputed whether raising the heels by calkins exercises any influence on the angle of the phalanges towards the ground; it now seems agreed that this is certainly the case, for the pedal and coronet joints at least, and for the former to a greater extent than for the latter. The position of the fetlock-joint and the fetlock angle are, however, scarcely affected by the dorsal flexion so produced in the pedal and coronet joints; raising the heels, therefore, has no effect on the suspensory ligament, but it is useful in inflammation of the perforans tendon.

Tenotomy is the only method of treating severe "knuckling" due to contraction of the tendons, but is only useful if no joint be involved, and if the contracted tendon be not adherent to its sheath or aponeurosis at some point below the seat of operation, because in order to allow the fetlock to resume its normal position, the lower end of the divided tendon must retract. Where the knee is simultaneously bent, the upper portion of the tendon must also be able to retract to allow the knee to straighten, but the operation is then seldom of use because the bent position is due to shortening in the flexor muscles of the knee and metacarpus. Tenotomy is useless in rheumatic tendinitis, because of the extensive adhesions existing between the tendons and aponeurosis. Before operating, lameness must be allowed to subside, one of the conditions of success

being that the limb shall afterwards carry some weight, without which the tendon further contracts.

Tenotomy aims at lengthening the contracted tendon. It may be performed in various ways, though the subcutaneous is the only really successful method. Some operate from the outer side and direct the incision either towards the suspensory ligament or towards the skin. The inside is preferable in operating on a fore-limb, because of the absolute guarantee this gives against injury of the metacarpal artery. The operation is, however, only valuable in young and high-priced horses, because recovery and restoration to work require ten to twenty weeks or even longer.

At the inner side of the leg, about the middle of the metacarpus,

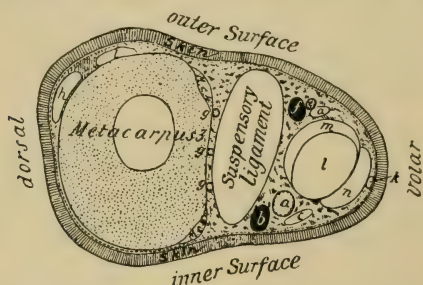


FIG. 480.—Section through the centre of the metacarpus.

a, Large metacarpal artery; *b*, metacarpal vein; *c*, inner plantar nerve; *d e f*, corresponding external structures; *g g g*, interosseous arteries; *k*, oblique branch from internal to external plantar nerve; *l*, tendon of flexor perforans; *m*, its reinforcing band; *n*, tendon of flexor perforatus.

the hair is shaved, and the entire metacarpus washed with soap and water and rinsed with sublimate solution. A ring of sublimate wood-wool is then laid round the point of operation, fixed by a bandage, and moistened three times a day with sublimate solution. In this way in twelve to twenty-four hours the metacarpus is made clean and nearly aseptic, so that healing without suppuration may be reckoned on with certainty provided the other rules of asepsis are carried out. Hands and instruments must be disinfected, and sterilised dressings employed.

The horse is cast on the affected side, and anæsthetised; the limb to be operated on may be left in the hobble and the pastern held forward by a sideline, or the limb may be removed from the hobble and held fully extended. An incision through the skin is made with a pointed bistoury midway between the knee and fetlock,

just over the flexor pedis perforans. If the tendon is adherent at this point to the flexor perforatus, a spatula should be passed between the tendons to make way for the knife, and section of the perforans may then be performed from behind forwards; otherwise,

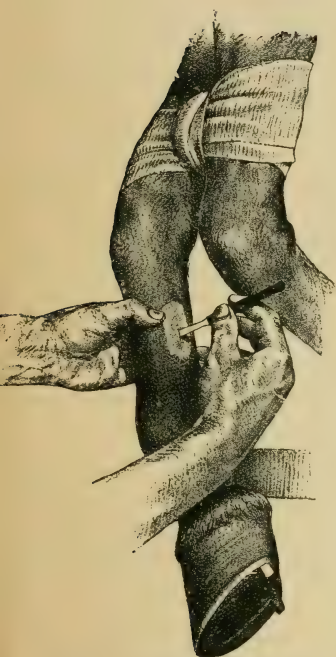


FIG. 481.—Tenotomy—first stage.

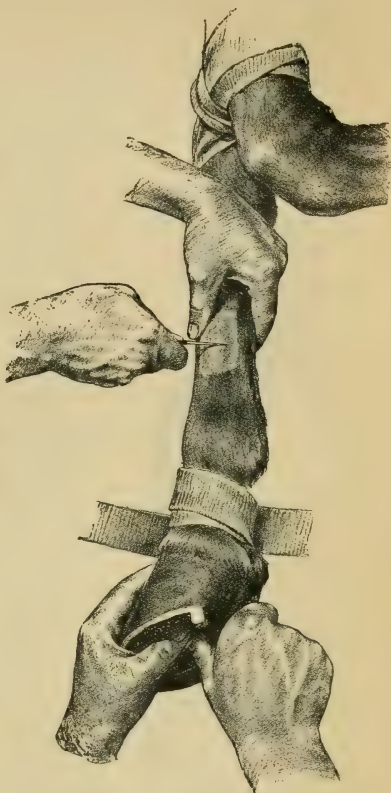


FIG. 482.—Tenotomy—second stage.

a blunt tenotome is inserted, with its surface lying close to the tendon of the flexor pedis perforans, and is pushed between this and the suspensory ligament until it can be felt at the other side. Its cutting edge is then turned against the flexor perforans, the phalanx extended by a rope or by an assistant pulling it forward, and the tendon divided by slowly lowering the hand in the direction of the

cannon bone. Should the ends of the tendon not retract after complete section, adhesions with the aponeurosis probably exist, and must be divided or broken down.

By introducing the tenotome close to the perforans tendon the danger of injuring the large metacarpal artery is avoided. Sometimes small cutaneous and subcutaneous veins are divided, causing a little bleeding, but this is of no consequence. The surface of the wound is then washed with sublimate solution, a tampon of cotton applied to the little incision, the limb surrounded with sublimate wood-wool or similar material, a circular bandage applied, and the horse allowed to rise. If the operation is to prove successful, the fetlock-joint ought now to appear moderately extended.



FIG. 483.—To illustrate the peculiar gait after tenotomy. The horse treads on the heel.

Provided the dressing is not wet through by discharge, it may be left in position for a week, when the skin wound will be found completely closed. The dressing may also be saturated with sublimate solution and changed the next day ; it must, of course, be changed should it become soaked with blood. After removing it the leg should be rinsed with sublimate, or carbolic solution, any blood-clots washed away, and fresh dressing applied.

With these precautions antisepsis is maintained without difficulty, even if the metacarpal artery has been cut through.

In the event of such an accident, the dressing must be very tightly applied, moistened with sublimate, and changed, with proper precautions, in twenty-four to forty-eight hours.

As a rule, healing proceeds much better where only the flexor perforans is divided. The animal's usefulness is sooner restored, and, in consequence of weight being placed on the limb at an earlier period, excessive contraction of the cicatricial tissue is less to be feared. Where the flexor perforatus is also divided excessive dorsal flexion may occur, or the animal may prove unable to stand on the limb, and fresh contraction take place. For this reason tenotomy often fails ; but it is undesirable to follow Fogliata, who first divides the perforatus tendon, and when this is not sufficient, cuts through the perforans. If the horse, when quietly standing, places sufficient

weight on the leg, it may be placed in a stall, better still in a box: otherwise, on the second day after operation, it should be slowly walked for a quarter to half an hour, preferably on soft ground. This is almost indispensable to prevent cicatricial contraction and ensure restoration of the normal fetlock position. The frequent relapses noted are due to neglect of this precaution. For a similar reason, operation must be delayed until pain has almost disappeared, otherwise the requisite weight cannot be put on the limb. Experiment shows that mechanical extension of the cicatricial tissue is necessary to give the newly-formed tissue the character of tendon substance.

It almost goes without saying that, either before or soon after operation, the foot must be restored to its proper form by judicious paring. Animals can sometimes be returned to work in ten weeks, though it is advisable in most cases to prohibit work for a much longer interval, or until local pain has disappeared. The cicatricial tissue is sufficiently solid in from thirty to forty days to assure continuity of the tendon, but repair that will stand the strain of ordinary draught-work is not completely effected before six or seven months from the date of operation. When lameness persists, it may generally be removed (in animals which cannot be kept idle) by dividing the median nerve. Möller repeatedly performed neurectomy and tenotomy simultaneously in horses belonging to a large horse-owner, who loaded his horses heavily, and worked them hard; and where lameness was still marked, has treated both contracted tendons and shot-over fetlocks, due to contraction of the suspensory ligament, at the same time, and rendered horses workable again even in four to five weeks.¹ Median neurectomy is first performed, then tenotomy. For a



FIG. 484.—Excessive dorsal flexion after section of the perforans and perforatus tendons—the “knuckling” at the fetlock is due to contraction of the suspensory ligament, and has not been affected by the operation (from a photograph).

¹ Möller's own statement: “Wurde . . . die Pferde oft schon nach 4—5 Wochen arbeitsfähig.”

description of median neurectomy, see the section on "Ringbone" hereafter. As the neurectomy wound rarely heels by first intention, it must, during the first few days, be frequently cleansed to prevent discharge running down and infecting the lower point of operation. The excessive dorsal flexion (Fig. 484) following simultaneous section of the perforans and perforatus tendons, particularly in heavy horses, may be removed by wearing a long bar-shoe. If needful, an iron crutch, with fork-shaped arms reaching to a point just below the fetlock-joint, or Bourgelat's "swan's-neck" support may be affixed to the heels of the shoe, to afford the joint a surface on which to rest. Sometimes the suspensory ligament is contracted, causing



FIG. 485.—Special shoe for "knuckling."

the fetlock to remain upright, even after complete division of the perforans and perforatus tendons, a condition which experience tends to show is incurable. It occurs not only after strain and thickening of the suspensory ligament, but also after severe and old-standing "knuckling."

Horses which are "knuckled," if worked slowly and on soft ground, may be made useful for a long time by applying a long-toed shoe, though this will not cure or even improve the original disease. Tendinitis occurring during infectious disease, especially during influenza, requires special attention, while, to prevent relapse, such animals should not be too soon put to work, or otherwise exerted; during the convalescent stage particular caution is called for, and the tendons may be bandaged with advantage.

If, during the course of an infectious disease, inflammation of the tendons or tendon sheaths occurs, mild stimulation and bandaging constitute the best primary treatment. When pain is severe, lukewarm disinfectant foot-baths often relieve it. In other cases, warm moist applications and moderate pressure on the diseased tendons may be resorted to. Sometimes the condition disappears with unexpected rapidity, but generally returns in the same or some other spot, and may often involve both limbs. The degree of swelling and pain forms an index to the gravity of the condition, which sometimes resists blistering and even firing, and not infrequently proves incurable. In other cases, and especially where there is no marked anatomical change, recovery may occur after many months.

V.—KNUCKLING AT THE FETLOCK IN FOALS.

IN thoroughbred stock, less frequently in other breeds, foals at birth are sometimes unable to move properly owing to excessive knuckling of the fore or hind fetlocks. Three degrees of knuckling are recognised : (1) the cannon and pastern are in the same line, the angle of the fetlock being effaced ; (2) the fetlock is carried forward, forming an angle open behind ; (3) the fetlock is projected forwards beyond a vertical line rising from the toe of the foot.

The upright position of the fetlock prevents the flexors taking their proper part in sustaining weight. This peculiar deformity generally affects both fore legs, often causing the animals to walk with the front of the phalanx on the ground and preventing their standing upright. It also develops, though rarely, during the first two or three years of life, but never in such a serious form.

The cause has not been satisfactorily explained. Knuckling in foals has been attributed to infection derived from the mare during gestation or contracted soon after birth, to myositis of the flexors of the foot, and, when knuckling is associated with bent knees, to myositis of the flexors of the metacarpus. Fröhner mentions that congenital cases are often due to weakness of the extensors, and some breeders from observation of the produce of certain stallions regard the condition as hereditary. Franck considers it due to congenital contraction of the flexor tendons existing at the time of birth. Others ascribe it to abnormal position of the fœtus in utero, whilst Lafosse thinks it arises from disproportion between the stallion and mare, the bony framework being excessively developed when the stallion is too large. As large animals are especially affected, and as, in general, only the phalanges suffer displacement, the cause must lie between the point of insertion of the flexor perforans and its reinforcing ligaments. There are two possibilities : either the tendons are too short or the metacarpus is too long. The first may be referred either to defective development or subsequent shortening of the tendons. Whether, in such case, the development of the flexor tendons is interfered with by the position of the fœtus in utero, or whether contraction occurs, or whether the long axis of the metacarpus is excessively developed, so that the tendons are relatively too short, or whether again the point of origin of the muscles is abnormal, is for the time at least undecided. Perhaps the condition may be caused in more than one way.

Abnormal position in utero would probably interfere with development of the joints and muscular tissue. Increase of pressure

on the posterior portions of the joints, caused by continued volar flexion, would check the growth of bone, while diminution in the anterior portions of the joints would favour its production, and thus tend to thrust the phalangeal joints more and more into a position of volar flexion. The rapidity with which the condition yields to proper treatment, however, seems to contradict this theory.

Symptoms. The most important symptom is the abnormal volar flexion of the fetlock-joint. No disease of the tendons or



FIG. 486.—Double-sided “knuckling” in a two-year-old colt (from a photograph).

muscles can be detected, though they appear tensely stretched when the fetlock is upright. Where the condition is well developed, the limb is incapable of bearing weight. The new-born foal rears itself up, but may be unable to stand and may die from exhaustion, or necrosis produced by lying (bed-sores). Sometimes the animals stand on the front of the fetlock-joint, and thus produce open joint or other serious injury. Where the appearance of the disease is delayed the animals can stand, but move with difficulty, and after some time show excessive uprightness of the hoof. The condition is distinguished from contraction produced by tendinitis by the absence

of changes in the flexor tendons. In knuckling of the hind fetlocks the feet may be turned inwards producing distortion of the pastern.

Course and prognosis. In newly-born foals the abnormal position is usually seen on the first attempt to stand, but disappears under proper treatment in eight to fourteen days. Not infrequently these apparent cripples develop into very useful animals. Sometimes improvement occurs first in one limb, the other meanwhile retaining its abnormal position. In calves the disease usually takes a favourable course.

When appearing in the second year after birth the disease takes

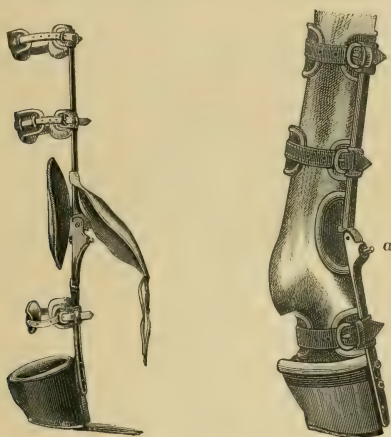


FIG. 487.—Friebel's extension apparatus.

a less favourable course, and may, indeed, never entirely disappear. In other cases improvement follows proper treatment, though complete cure, *i.e.*, recovery of the normal position, is rare.

Treatment. The great extensibility of the tendons in foals favours early and complete recovery. It is, therefore, important to practise forcible extension, and to such a degree that the tendons are stretched and the fetlock brought into an oblique position. For this purpose the foal is cast, the phalanges extended as far as possible and fixed in this position, either by using a plaster bandage or applying a strong leather splint. Ehrle uses a plaster bandage or a glue bandage and splints. The parts are freely padded with wadding to distribute pressure. The degree of success is often astonishing, especially when treatment is early resorted to. Weight can often be placed on the

limb after a few days ; the bandage should then be removed, because the weight of the body acting through the oblique position of the pastern will produce further extension of the tendons, and is quite sufficient to prevent contraction. In all cases attention should be paid to the hoofs, and if necessary the heels should be lowered. Friel's extension apparatus (Fig. 487) appears very practical. It consists of a small leather shoe, provided in front with a well-padded iron splint. By means of a screw the splint can be so fixed as to exercise pressure on the anterior surface of the fetlock-joint and thrust the latter backwards, *i.e.*, into its normal position.

Eassie saw "knuckling" in all four limbs in a five months old foal. In front the disease was cured by tenotomy, behind by proper shoeing. Tenotomy cannot be recommended for knuckling in foals, the results being often disastrous, but sometimes it is performed to arrest the progress of sloughing-sores on the front of the fetlock or pastern caused by contact with the ground. Ostertag cured congenital contraction of the tendons in a foal in four weeks by applying a wooden splint and plaster bandages, which were changed several times. As the dressing accommodates itself to the gradually improving position of the fetlock, Ostertag considers it necessary to change it two or three times. Hofer had a gutter-shaped splint made from pine wood which reached to the fetlock ; he states having seen recovery occur in one to three weeks.

"Knuckling," which sets in two years or so after birth, even when unaccompanied by inflammatory disease of the tendon, can seldom be so completely removed as to restore the animal's working powers. Trager, however, states having cured cases by section of the perforans and perforatus tendons.

Eichbaum suggested the use of a long-toed shoe ; Bombach, who regarded the disease as a secondary matter resulting from uprightness of the hoof, cured it by freely lowering the heels. Matz applied blisters and recommended turning the animal out.

Brunet used a peculiar extension apparatus, which started from the shoe and exercised pressure on the front of the knee-joint. Experience shows that treatment should depend on the degree of displacement ; when slight, it is sufficient to freely lower the heels, but should this be unsuccessful, a long-toed shoe may be used. If needful, tenotomy can be performed, it being sometimes sufficient to divide the flexor perforans. Tenotomy is, however, seldom necessary, and can only be recommended as a last resort.

VI.—BENT KNEES IN HORSES.

IN aged animals this condition results from excessive contraction of the external and oblique flexor muscles of the metacarpus, and is brought about by wear, hard work, senile changes, or disease of the carpus or metacarpus. In foals it may be congenital, or associated with knuckling at the fetlock; and in young horses beginning regular work it may be connected with multiple splint formation, arthritis of the knee, or synovitis of the flexor sheaths. Bent knee also occurs in the dog, sometimes after distemper, and is due to retraction of the flexors of the carpus.

Treatment. Disease of the carpus, or of parts below it, should be treated on general principles. In other cases bent knees may be temporarily straightened by blistering the posterior surface of the limb from the elbow to the fetlock, afterwards turning the horse out for a month or two. Bent knee uncomplicated by carpal or metacarpal disease may be successfully treated by supercarpal tenotomy or subcutaneous section of the external and oblique flexors of the metacarpus. The procedure is similar to that followed in performing tenotomy of the flexors of the foot. The horse is cast on the side opposite to the bent knee, and the limb is held extended by two sidelines, one applied to the fore-arm and pulled backwards, the other to the fetlock which is pulled forwards. In front of the anterior edge of the external tendon, from two to three inches above the supercarpal bone, a small incision is made through the skin and fascia, and a probe-pointed tenotome is then carefully passed in front of the tendon which is divided from before backwards. The wound is sutured and protected with an antiseptic dressing. For a few days the horse should be placed in slings; and if the result should prove unsatisfactory, the oblique flexor tendon may be divided in the same manner, through an incision between the tendons and about an inch above the first made wound. In some cases, section of the perforans tendon is necessary before the knee can be fully extended. Supercarpal tenotomy is an effectual remedy for bent knee in the dog, in which section of both the external and oblique flexors is required. The incision is made immediately above the supercarpal bone or close to the insertion of the tendons.

VII.—SPLINTS.

SPLINTS are bony enlargements developed between the large and small metacarpal bones, generally on the inner side, less commonly on the outer side of the leg. They are very common in horses, but

rare in ruminants. Splints also occur on the hind limbs, and usually on the outer side of the shank. Jordanus Ruffus described splints as *supraossa*, and Solleysel distinguished five varieties of them. At first they were regarded as secretions from the bone, and it was only in the nineteenth century that their dependence on inflammation of the periosteum was clearly demonstrated. The real disease, *i.e.*, the condition causing lameness, is an osteo-periostitis associated with formation of enlargement. Two periods can, therefore, be distinguished: the first that of inflammation; the second that of complete development, in which inflammation is absent. During the first, lameness is therefore very general, but disappears during the second.

The process usually starts in the periosteum or in the interosseous ligament, which fixes the internal small splint bone to the cannon bone. Irritation of the bone and deep layers of periosteum causes a productive osteo-periostitis, and the process of splint formation is completed by ossification of the newly-formed material. The size of the splint depends on the extent of surface involved and the duration of the inflammation and varies between that of a three-penny and a five-shilling piece. The splint itself generally assumes an elongated form lying parallel with the small splint bone. When the inflammatory process has subsided, and the formation of the splint is complete, pain and lameness generally disappear, though the splint itself remains as a blemish. In many cases, however, especially in young horses, severe work is again and again followed by lameness, causing the disease to persist for a long time. The mature enlargement gradually diminishes, sometimes by becoming flattened, sometimes by the neighbouring bone becoming thickened, and under certain circumstances may so far recede as to require a careful examination to detect it. The late H. G. Rogers drew attention to the frequent occurrence of splints on the metatarsal bones, and suggested the possibility of their causing lameness. Though they undoubtedly do so in some cases, as Dollar has convinced himself, the proportion of such cases is not large.

The cause of splint formation consists in traumatic irritation of the interosseous ligament, periosteum and bones. On account of their almost invariably occurring on the inner side, the view was once held that splints were produced by striking. Havemann was the first to expose this error, and to point out the longish shape of the splint, and the fact that injury of the skin is very rare. He directed attention to the construction of the carpus, and especially to the position of the trapezoid bone, and viewed this as a cause

of the disease. Whilst on the outside the unciform rests partly on the outer small splint bone, partly on the metacarpal bone, on the inside the trapezoid rests almost entirely on the inner small splint bone. This explains why faulty action or unequal distribution of pressure in the knee may throw an excessive load on the inner small metacarpal and cause ruptures in the interosseous ligament attaching the small to the large metacarpal. The fibrous union between the bones in young animals explains the frequent occurrence of splints during early life. In aged horses the disease seldom occurs.

This explanation of Havemann's was generally viewed as correct, until Dieckerhoff raised a doubt about it, and stated that the disease of the periosteum was produced by the pull of the fascia of the fore-arm. He describes splints so produced as "spontaneous," in contra-distinction to those caused by blows, which he terms "traumatic." The lower insertion of the fascia of the fore-arm is partly into the metacarpal bones, especially the inner small metacarpal, partly into the subcutaneous connective tissue. Ruptures of it, and especially of its point of insertion into the bone, are said by Dieckerhoff to give rise to disease in the subfascial connective tissue, which disease extends to the periosteum. The facts adduced by Dieckerhoff in support of this modification of Havemann's view seem insufficient, and by no means conclusive. There is much evidence in support of Havemann's showing. The disease generally begins in the interosseous ligament, between the small and large metacarpal bones, whilst no disease process of any kind can be detected in the fascia. Nor can oedematous swelling of the subcutis be regarded as an infallible sign of the condition referred to, for it is scarcely ever absent in periostitis in other positions. To this must be added that inflammation may also be caused by violent tension on the other ligaments, which become attached to the inner small metacarpal bone, and may lead to disease in the spot in question. For prognosis and treatment, it is, of course, of little importance which view one takes.

Splints may be divided into two classes—those due to unequal distribution of pressure, and those due to blows. The two kinds admit of easy clinical distinction. The first is generally of a long shape, and is found in the groove between the small and large metacarpals or on the small metacarpal alone; not infrequently several lie one above the other, having been formed simultaneously or soon after one another. Those produced by blows are generally further forward and on the large metacarpal, *i.e.*, they appear in front of the small metacarpal, are generally of a rounded shape, and are discrete. Cicatrices or injuries of the skin cannot always be detected.

Horses with bad action often strike themselves. The weight is irregularly distributed in their joints, and therefore such animals have a double disposition towards the production of splints. This is particularly true of those which turn the toes either outwards

or inwards excessively, as well as of those which stand with the legs widely extended or too close together. Defective shoeing may lead to splint formation by its favouring striking and unequal distribution of weight in the joints. During military evolutions injuries are often caused by striking, by unequal distribution of weight, especially in restive horses, and also by the animal being tired or constitutionally weak. Continued severe work on stones in large towns favours the production of splints. Coarsely-bred animals suffer oftener than well-bred, and the splints are usually larger. Inasmuch as defective formation is often a contributing cause of splint, the inheritance of a pre-disposition to their production can be explained without resorting to Didfield's idea that the drinking water has some influence.

Many peculiarities of the disease still require explanation, such as its simultaneous and exactly symmetrical appearance on both fore legs, even in old horses, and the more frequent appearance on the left fore limb. The reports of the Prussian army show that splints occur twice as often on the left fore limb as on the right. It is possible that the frequently performed "right gallop" may afford an explanation of this.

Symptoms and course. (1) Lameness. The pain resulting from osteo-periostitis produces lameness, which is therefore a regular accompaniment of the development of splints. It is seldom absent, but its character depends partly on the position, extent, and intensity of the process, partly on the work done and on the animal's sensitiveness. Lameness is less common in coarse-bred than in well-bred horses. When periostitis is caused by mechanical injury, lameness disappears with its subsidence, and only returns if the injury be repeated. In such cases it last about three weeks. Partial rupture of the interosseous ligament recurs very easily, causing the lameness not only to continue for longer periods, but also to return, and therefore splints of a longish shape occurring on the small metacarpal continue to interfere with the animal's usefulness for a long time, frequently for many months. In splint near the knee there is danger of inflammation extending to the knee-joint; the lameness then continues for longer periods, sometimes indeed becoming chronic, from changes in the knee producing arthritis, and from mechanical interference with the mobility of the joint by large exostoses in its immediate neighbourhood. Splints at this point following on injury often produce chronic lameness.

Lameness may therefore be caused—

1. By periostitis or osteo-periostitis.
2. By inflammation of the knee-joint.

3. By formation of extensive exostoses near the knee, which interfere with free movement. The suggestion that lameness is caused by the splint pressing on the suspensory or flexor tendons is not well founded, though sometimes an exostosis is formed under the suspensory on the posterior surface of the large metacarpal bone.

In general, splints produce lameness, in the free limb (swinging leg lameness) and abduction of the limb; the knee is not fully flexed. The lameness is better seen on hard than on soft ground, is much more marked at the trot than at the walk, and is usually aggravated by exercise. Weight is generally placed on the limb, and the hoof in most cases is put down firmly and in the usual manner. The excessive tension in the fascia of the fore-arm during the last phase of movement, just before the limb is lifted and during its extension, causes painful pressure on the inflamed periosteum.

Abduction is particularly marked when the knee-joint is also involved. Extensive exostoses interfering with movement of the knee can be detected by passive movement; attention is sometimes drawn to them by the knee being held stiffly, and only partially flexed during movement.

(2) Local examination. The development of splint is characterised by slight swelling, increased heat, and pain on pressure. The swelling shows a certain degree of hardness, but in consequence of oedema of the skin is at first of doughy consistence. This gradually disappears, the swelling becoming firmer and harder. To detect pain the opposite foot is lifted, and the hand placed with the thumb resting on the outside, the fingers on the inner side, of the affected metacarpus. By passing the fingers from above downwards, it is easy to estimate the tenderness of the periosteum. To prevent mistakes, the same process should be gone through with the sound limb. In practised hands this examination is perfectly easy, though in some cases care is required to avoid mistaking prominence of the "button" on the small metacarpal for splint. On the other hand, inflammation of the skin is sometimes difficult to distinguish from periostitis, though, as a rule, painful lameness is here absent. Nevertheless, the other portions of the limb should always be carefully examined in order to confirm the diagnosis. This is particularly necessary when the pain produced by pressure is slight.

Prognosis is generally favourable, especially where the position and character of the splint point to mechanical injury. Exostoses of a longish form occurring on the small metacarpal and in young horses are apt to be troublesome. The chance of recovery is less if, in consequence of defective formation of the limb, the parts are

likely to be struck by the other foot. Prognosis is doubtful when the knee is coexistently diseased, or when splints have formed close to it, and opinion should be reserved even when the patient, after a long rest, shows no lameness. In cases of this kind in young horses, the splints which remain not infrequently cause renewed lameness on every attempt to work, and, as a rule, never disappear completely.

The treatment of splints first demands the removal of the cause. Skilful shoeing is important to prevent striking and to effect a proper distribution of weight, but scarcely comes within our present province. Rest is essential, particularly when the disease is clearly not of mechanical origin. The splints so common in foals and yearlings often disappear spontaneously, and it is better to wait a reasonable time rather than produce permanent blemishes by undue haste in treatment.

Local applications of cold water, mercurial ointment, tincture of iodine, &c., are seldom of use. In fully-grown horses a blister may be indicated provided the skin is uninjured. Cantharides ointment, though often recommended, has less effect than mercurial preparations, especially sublimate, employed in concentrated solution. This was a favourite application of the older practitioners, but its use demands caution. One part of sublimate dissolved in four parts of spirit is applied with a feather, and sharply rubbed in. The cutaneous and subcutaneous swelling produced exercises general pressure on the inflamed periosteum, and limits exudation therein. Firing answers the same object, though, without doubt, the subsequent rest is of great importance.

When objected to, these methods may be replaced by a pressure dressing. A mixture of equal parts of mercurial ointment and lanolin should be rubbed in smartly once a day, and a proper pressure bandage applied.

Periosteotomy, though revived from time to time, has not been much practised. The operation sometimes shortens the duration of the pain and tension in the periosteum which cause lameness, but usually it neither diminishes the morbid changes nor lessens the lameness, while it sometimes occasions considerable thickening, and even necrosis of bone. Perhaps these troublesome complications might be avoided by strict antisepsis, but the recorded cases are insufficient to settle the question.

Needle firing has also been recommended and is generally successful. The best method is probably that described by Dollar as "antiseptic firing," where the parts are prepared and afterwards treated like a

surgical wound. Cauterisation is followed by the application of a vesicant.

Ablation of splints by the use of the gouge or chisel and mallet has been practised since Lafosse's time, but seems a barbarous method of removing a growth which very frequently denotes the need for local increase of substance. It could only be justified where the splint formed a mechanical impediment to movement, as, for instance, when the animal was in the habit of striking it with the opposite foot.

Reduction of splints is assisted by massage and methodical compression. The former can seldom be continued sufficiently long, though, when the necessary assistance is available, the splint may be diminished by rubbing it daily with a firm leather pad or similar object. The treatment must, however, be persevered with for months. A better plan is as follows :—A piece of lead (a leaden bullet, beaten flat) or thick sole-leather is fixed over the exostosis with moderate firmness by a bandage. The pressure thus produced, if continued for some weeks, often brings about considerable diminution in size. Care is needed to avoid causing necrosis of skin, and it is therefore well to change the dressing frequently, where possible daily, and examine the skin. By employing massage, resorption is hastened.

A peculiar periostitis on the large metacarpus (occasionally on the metatarsas), termed "sore shins," is seen in young race-horses. It always appears suddenly after violent gallops, and is usually confined to the lower half of the bone. The affected limb is rested, or if both limbs suffer, the weight of the body is alternately shifted from one to another. When moving, the leg is not properly lifted, and is extended stiffly; the horse goes "short." Soon after, a hot, very painful swelling (periostitis) appears on the front of one or other, sometimes of both shin-bones. It usually disappears in a few weeks, though superficial necrosis of the bone has occasionally been observed—perhaps, in consequence of the treatment. The disease occurs almost solely during the first two years of life, is seldom seen during the third and fourth years, and never occurs in old horses. Subcutaneous periosteotomy, formerly recommended, is of very questionable value. Unless performed with strict antiseptic precautions it may lead to suppurative periostitis—a still more dangerous condition than "sore shins." Complete rest, low diet and warm moist applications are usually sufficient in the early stages. Later, a mild blister is useful.

If pus form, an ample depending opening must be made and the fullest antiseptic precautions taken. Warm antiseptic baths,

in which the leg is immersed to above the knee, may be continued for several hours every day until pus formation and pain diminish. Dry dressings are then useful. The horse should afterwards have several months' rest and be very slowly brought into training.

E. DISEASES OF THE FETLOCK AND DIGIT.

In solipeds, the digit consists of three phalanges, the pastern, coronet, and pedal bones, with two sesamoids at the fetlock, and a third (navicular bone) within the hoof. In ruminants, two completely developed and two rudimentary digits exist, with four sesamoids, and two navicular bones. The pig has four digits, two true and two rudimentary; eight sesamoid and four navicular bones.

In the digits of carnivora, the first consists of two, the others of three phalanges. Each digit has two sesamoid bones, whilst the navicular is replaced by a prominence on the third phalanx.

The horse's fetlock, a complete ginglymoid joint, possesses a capsular ligament, which encloses the joint in front of the lateral ligaments, and its single synovial membrane when distended forms a dilatation which extends upwards between the branches of the suspensory and constitutes "articular wind-gall." The intersesamoid ligament connects the two sesamoid bones, which are attached to the first phalanx by two lateral sesamoid and two inferior sesamoid ligaments, and to the metacarpus by the lateral ligaments of the fetlock and the suspensory. The inferior sesamoid ligaments are three in number: the superficial band is fixed below to the glenoid fibro-cartilage of the second phalanx and above to the base of the sesamoid bones; the middle ligament is attached to the back of the first phalanx and the base of each sesamoid, while the deep ligament is represented by a few crossed fibres which connect the sesamoids with the upper part of the back of the first phalanx. The superior sesamoid (suspensory) ligament descends from the lower row of carpal bones and upper end of the metacarpus to near the "buttons" where it bifurcates. Each branch is implanted on the excentric surface of the corresponding sesamoid, and a portion of each band is continued downward and forward to join the extensor pedis tendon in front of the pastern. The fetlock joint is so fixed by the upper and lower sesamoid ligaments as to prevent excessive dorsal flexion and assist the function of the flexor tendons. The strong lateral ligaments, assisted by the suspensory in conjunction with the cylindrical form of the articular surface, prevent any side movement. The flexor tendons in crossing the sesamoids are firmly braced in position by a strong aponeurosis which assists in supporting the joint.

The coronary is an imperfect ginglymoid joint lying about an inch above the upper margin of the hoof. On account of its flat articular surface, it allows of limited side movements, especially when in a position of volar flexion. The anterior capsular ligament is formed by the expanded extensor pedis tendon. At the sides are two stout lateral ligaments, whilst behind is the glenoid fibro-cartilage. The synovial membrane presents posteriorly a dilatation which extends upwards behind the lower part of the first phalanx. Each lateral ligament sends a band downwards to form part of the postero-lateral ligaments of the pedal joint. The

glenoid fibro-cartilage is attached to the first phalanx by three fibrous bands, and by the superficial inferior sesamoid ligament to the base of the sesamoids.

The pedal-joint lies within the hoof. It is an imperfect hinge-joint,

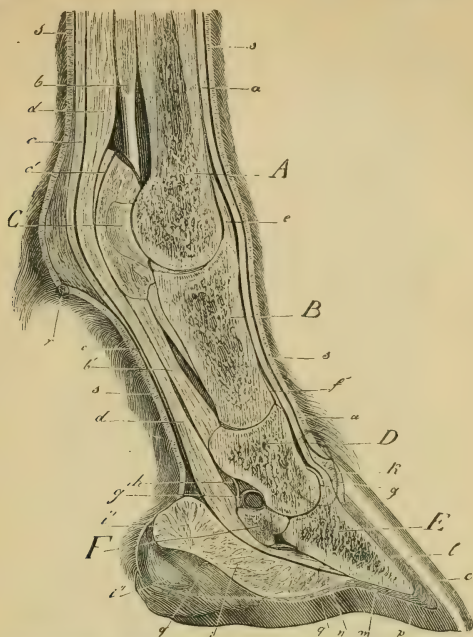


FIG. 488.—Perpendicular mesial section of right fore foot (the position of the lower bones is shown rather too upright). *A*, Lower end of great metacarpus; *B*, suffraginis or first phalanx; *C*, inner sesamoid bone (to render the bone visible, a portion of the interseamoid ligament has been removed); *D*, coronet bone; *E*, pedal bone; *F*, navicular bone; *a*, extensor pedis tendon; *b*, superior sesamoid or suspensory ligament; *b'*, inferior sesamoid ligament; *c*, flexor pedis perforatus tendon; *c'*, great sesamoid sheath; *d*, flexor pedis perforans tendon; *e*, capsular ligament of the fetlock-joint; *f*, capsular ligament of pastern-joint; *g* and *g'*, capsular ligament of coffin-joint; *h*, bursa of flexor pedis perforans; *i*, plantar cushion; *i'*, portion of plantar cushion forming the bulbs of the heel; *k*, coronary band; *l*, sensitive wall; *m*, sensitive sole; *n*, sensitive frog; *o*, horny wall; *p*, horny sole; *q*, horny frog; *r*, ergot at base of fetlock; *s*, skin.

with less liberty of motion than the coronary joint. It has five ligaments; an interosseous between the navicular and coffin bones, and two pairs of lateral ligaments. The synovial membrane presents on each side a small dilatation between the lateral ligaments, and a larger pouch which extends upwards on the back of the second phalanx. The tendon of the extensor pedis, expanding as it descends, passes over the anterior surface, that

of the flexor pedis perforans over the posterior surface of the three phalanges, while the tendon of the flexor pedis perforatus passes behind the perforans over the fetlock and coronary joints. The metacarpo-phalangean aponeurosis forms a strong fibrous brace for the flexor tendons at the sesamoids and pastern, and supports and protects the nerves and blood-vessels. In company with the sesamoid ligaments, the extensor pedis and flexors perforans and perforatus tendons act in fixing the fetlock joint : with the posterior coronary assisted by the lateral ligaments, they also fix the coronet and pedal joints, and thus sustain the weight of the body.

The terms dorsal and volar flexion are hereafter used to describe the movements occurring in the digit : the first indicates anterior flexion, the movement produced by the extensor, or resulting from weakness or rupture of the flexors ; the second indicates posterior flexion, or movement produced by the flexor muscles.

I.—LUXATION OF THE PHALANGES.

THE union of the three phalangeal joints is so strong that displacements (luxations) are exceedingly rare, and must always be preceded by extensive rupture of ligaments or tendon. Luxation of the fetlock-joint is seen in race-horses after complete rupture of the flexor tendons ; the lower end of the metacarpus then passes downwards over the posterior margin of the articular surface of the os suffraginis, causing excessive dorsal flexion of the fetlock-joint. Less frequently, the metacarpus is displaced anteriorly ; this indicating rupture of the lateral and sesamoid ligaments. Lateral displacements are exceedingly rare, and are necessarily accompanied by rupture of the lateral ligaments. They are sometimes produced by violent struggles to free the foot which has accidentally become fixed, as, for example, between railway-metals. Wilhelm saw lateral displacement in the hind leg of a horse which had run away and had fallen. The joint was directed outwards. Siedamgrotzky has described three similar cases. In other animals luxations of the phalanges are still less common.

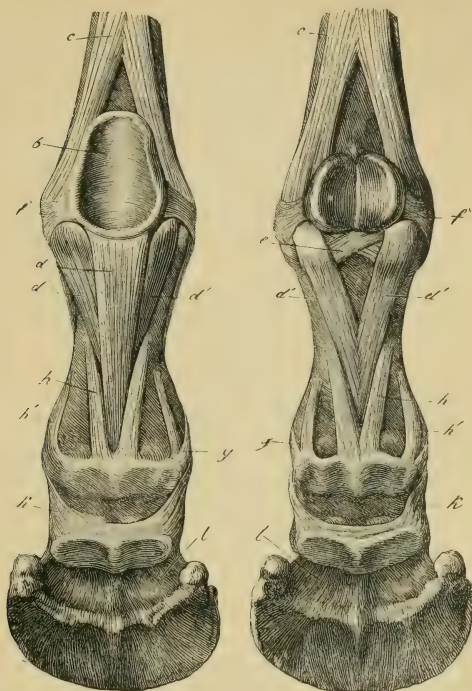
The diagnosis is easy. The altered position of the joint, and the changes discovered by manual examination, leave no room for doubt.

The course of luxations is almost always unfavourable, on account of the excessive rupture of tissue. The larger animals either die from decubitus, or more or less marked lameness remains which prevents them working. Reported cases, however, show that recovery may occasionally take place.

Wilhelm records recovery in eight weeks in the above-described case. He placed the horse in slings, and after reducing the dislocation, applied a wooden splint fastened to the metacarpus by straps.

Treatment was directed to subduing inflammation, and later a dressing and wooden splint, provided with a hinge over the fetlock-joint, were applied.

Schellhase has seen similar cases. In one it was possible not only



FIGS. 489-490.—*a*, External lateral ligament of pastern-joint; *b*, intersesamoidean ligament; *c*, superior sesamoidean ligament; *d*, middle limb of inferior sesamoidean ligament; *d'*, lateral limb of inferior sesamoidean ligament; *e*, cruciate ligament; *f*, lateral sesamoidean ligament; *g*, outer lateral ligament of the coronary-joint; *h* and *h'*, posterior corono-suffraginal ligaments; *i*, outer lateral ligament of pedal-joint; *k*, postero-lateral ligaments of navicular bone; *l*, fibrous sheath of synovial membrane of coffin-joint.

to place the os suffraginis at a right angle with the large metacarpal, but a wound existed which admitted the finger between the os suffraginis and metacarpal bone; nevertheless, recovery occurred. Such cases are, however, quite exceptional. As a general rule the horse must be destroyed.

Luxation may occur spontaneously, or without any particularly violent effort. A pure-bred stallion showed very severe lameness alternately in both hind legs. Rheumatism was suspected and treatment directed accordingly. One morning the horse was found lying down with the left hind fetlock luxated. On being approached to apply a bandage, the horse attempted to rise and luxated the other fetlock. On post-mortem, the extensor and flexor tendons were found intact but the synovial capsules and lateral ligaments were ruptured. In cases of this kind it is almost certain that inflammation or degenerative changes must have previously occurred in the lateral ligaments.

Johne gives the result of a post-mortem on a horse after luxation of the *os pedis*, where the lower end of the *os coronæ* had been displaced backwards and outwards, and lay above the *os naviculare*. The capsular ligament was consequently torn, and the flexor perforans ruptured and inflamed.

Treatment follows general principles. Reposition and control of inflammation are, however, very difficult. Anæsthesia is generally necessary before reduction can be effected.

II.—FRACTURES OF THE PHALANGES.

In the horse, fissures and fractures are commonest in the *os suffraginis*, comparatively rare in the *os coronæ* and *os pedis*. Such fractures may be transverse, longitudinal or comminuted, simple or compound. They are often the result of violent slips or sudden turns, and therefore are especially frequent in race-horses. They may also be caused by jumping or falling in races, but in addition occur in heavy van-horses employed for slow draught, particularly in winter when the roads are frozen. In riding-horses a frequent cause is sudden turning, simultaneous fracture of the *os suffraginis* in more than one limb being produced in this way. Röder saw in a horse, transverse fracture of both front and of the right hind pastern bones following a fall. Wentworth describes fracture of both front pastern bones in a mare. Whether a peculiar predisposition existed or whether the cause was the sudden strain thrown on the still intact bone in consequence of the first fracture, could not, of course, be decided. Tuson, in the above-described case, found a want of inorganic substances in the fractured *os suffraginis*, but, somewhat characteristically, gives no particulars of any analysis. In solipeds generally, and race-horses in particular, fissure of the *os suffraginis* is not infrequent. It was first noted in England, and Robertson and Williams described split pastern as quite a common occurrence.

The condition is sometimes overlooked, being mistaken for strain of the joint. Prolonged rest in the stable seems to favour its occurrence ; many of the cases of multiple fracture, *i.e.*, fracture of the pastern in more than one limb, were seen in horses which had just returned to work after long illness. Peters made a series of observations, and explained why fissures of the os suffraginis almost always start from the middle depression (Figs. 491, 492, 493). According to his view, the split is produced by the prominence on the lower articular surface of the metacarpus at a time when weight is unequally distributed over the two articular surfaces of the pastern lying on either side of it. Violent rotary movements of the supporting limb act similarly, and explain why fissures follow sudden turning on the fore limbs. Sometimes the split extends through the entire bone as far as its lower margin, sometimes it passes towards one side. Not infrequently it is very short, and ends close below the upper articular surface, and is followed by osteo-periostitis and the production of an exostosis (Fig. 492).

Transverse fractures are also common in the horse, and affect sometimes the upper, more frequently the lower, end of the os suffraginis. They likewise result from unequal distribution of pressure during slips. In one case Möller was able to detect during life that the inner border of the upper articular surface had been broken away by the violent pull of the internal lateral ligament, the outer border by the pressure of the metacarpus (Fig. 494). Cases of transverse fracture, *i.e.*, cases where the fracture starts from the external lateral ligament and extends a varying distance downwards (Fig. 495) are not uncommon. That figured had been caused by suddenly throwing the horse on his haunches. Comminuted fractures of the os suffraginis are often seen. Johnes saw a transverse fracture unite in eight weeks without much callus formation ; Dressler found a race-horse's pastern broken into nineteen pieces ; Bonnard counted thirty-four pieces in a similar case.

Diagnosis may be easy or very difficult according to the nature and extent of the fracture. Usually, comminuted and simple fractures with displacement are easily recognised, but partial or complete fissures, as in split-pastern, may present great difficulty in diagnosis. At the first examination of the case, a positive diagnosis may be impossible, owing to the absence of crepitation, displacement or deformity, but later, in the course of a few days, the pastern becomes much swollen and very painful to manipulation.

When the lateral prominences of the bone are broken off, the fetlock-joint shows abnormal mobility. On the other hand, careful

examination is required to detect fissures. The sudden severe lameness, associated with volar flexion of the fetlock, is apt to give the impression that the case is one of distortion, and therefore the



FIG. 491.—Fracture of os suffraginis.



FIG. 492.—Fracture of os suffraginis with formation of exostosis.

limb should always be examined for fracture wherever lameness is of sudden onset and severe. In suspected split-pastern when passive rotation of the foot produces no crepitation, the anterior



FIG. 493.—Transverse fracture of os suffraginis.

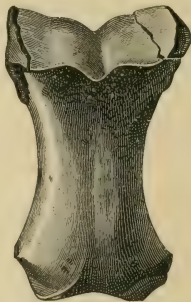


FIG. 494.—Double fracture of upper end of os suffraginis.



FIG. 495.—Longitudinal fracture of os suffraginis.

surface of the pastern should be firmly manipulated, beginning at the centre of the upper end. Starting from this point, a line of increased sensibility may be traced nearly corresponding to the course of the extensor tendon, and passing towards one or other

side of the bone. In most cases the fissure runs towards the outer side—a fact perhaps due to the smaller size of the outer division of the articular surface. During this examination the limb must of course be at rest, otherwise it would be impossible properly to estimate the degree of local pain. It is only after the lapse of some time that periostitis or exostosis can be detected at the upper end of the bone.

In solipeds fractures of the os coronæ are caused in the same way as those of the os suffraginis. They are a common sequel of the foot being caught between railway-metals. The bone is either split longitudinally or may be broken into several fragments. Henon saw the os coronæ broken into seven, Schrader into six, and Lafosse into twenty pieces. Henon saw a horse with fracture of the os coronæ in all four feet; sometimes only the ligamentous prominences are torn away. Möller mentions a case in which the bone was fractured into a number of pieces by a nail penetrating through the frog. Fissure and simple fracture are less common in this bone than in the os suffraginis.

Fracture is detected in the same way as in the suffraginis, and even when complete offers considerable difficulty. Crepitation in this region points to fracture of the os coronæ, provided the suffraginis is known to be intact.

Fracture of the os pedis is comparatively rare, though it has been seen by a number of observers. It is caused in the same way as fracture of the other phalanges, *i.e.*, by slips, particularly when animals are suddenly reined-up; but fracture of the pedal bone also follows injury by picked-up nails. Fracture is common in horses which have been “unnerved.” In this case its occurrence is partly explained by loss of sensation in the foot producing abnormal action, partly by alteration in the nutrition of the foot and changes in the bone. It is well known that after chronic lameness the nutrition of the bones of the affected limb generally suffers. According to Williams, fracture also results from the heels of the shoe being caught in railway-points, and, in heavy horses, from falls. Lemhöfer saw fissure of the os pedis produced by the horse striking the foot against a wall when jumping. This fracture united in four months, Schrader also noted fractures of the ossified lateral cartilage.

Diagnosis is very difficult, crepitation being rare. Only occasionally can it be produced by rotating the foot or pressing the heels together, and in its absence the diagnosis must be arrived at by a process of elimination, and by considering the history. Fracture of the os pedis may be surmised when severe pain is shown on attempts

to place weight on the foot, when the lameness is of sudden onset and attended with marked volar flexion, and when, at the same time, there is no acute inflammation of the flexor apparatus or other disease in the foot. Increased pulsation in the arteries does not occur until twenty-four hours after fracture. Wüstefeld found the superficial veins of the foot greatly swollen. Examination with farriers' pincers generally, though not invariably, causes pain. Slesarewsky saw fracture of the os pedis in consequence of a large portion of the hoof being torn away by the foot catching in some obstacle. Several pieces of bone were pulled off with the horn, but recovery followed the use of carbolic dressings.

Prognosis is favourable in fissures of the os suffraginis, from which many animals recover their usefulness if rested for six to eight weeks, provided laminitis does not attack the other foot during treatment. Exception, however, must be made for fractures extending to the articular surfaces, as these are generally followed by chronic lameness, though cases of complete fracture of the suffraginis have been known to recover without leaving a trace of lameness. Popow describes five cases of fracture of the os suffraginis which recovered under the use of the plaster bandage, though in two cases the fetlock-joint became ankylosed. In two cases the coronet-joint was affected, and in one both joints. In the case described by Halder, the animal could be put to light field-work after a month's rest, though slight lameness and thickening of the os suffraginis remained. Both Kretowicz and Wilhelm saw transverse fractures of the os suffraginis of hind feet unite completely in a few months. T. A. Dollar successfully set the fractured near fore pastern of "Sceptic" when the animal was six months old. The bone was broken into four or five fragments, and there was considerable displacement. "Sceptic" afterwards won thirteen races, many of importance. Foals and yearlings are much more hopeful subjects than full-grown animals, and even though a large callus forms and lameness persists for a time, the animal may eventually be rendered useful by neurectomy. As a rule, it is only worth while treating complete fractures when the horses are young, are valuable for breeding, or can be kept for a small sum. Compound fractures are generally incurable, though a few have been successfully treated by antiseptic methods.

Fractures of the os coronæ are still less favourable, recovery being incomplete, and lameness remaining even where the fracture is a simple one. As a rule, the bone becomes greatly enlarged, and excessive volar flexion, particularly of the fetlock-joint, sets in, and is followed by permanent lameness.

Fracture of the os pedis is less dangerous, because the parts are held in position by the hoof. Recovery chiefly depends on whether the other foot endures the strain of continued standing without suffering from laminitis. The prognosis is therefore ruled by the degree of pain. In Wüstefeld's case the hoof became enlarged from pressure exerted by the displaced fragments.

Compound fractures of the os pedis or navicular, caused, for example, by picked-up nails, are generally incurable, on account of the impossibility of securing asepsis, though, when the case is quite recent, and disinfection thorough, healing sometimes occurs within a reasonable time.

The treatment of fractures of the phalanges consists principally in perfect rest and the use of slings. In fissures of the os suffraginis a well-fitting linen bandage is generally sufficient if the horse be slung, though when a plaster bandage is applied, slinging may be unnecessary. Plaster bandages should extend well above the fetlock and as far down as the hoof in order to limit movement of the limb. Considerable care is required in padding the limb previous to applying the bandage itself, otherwise troublesome sores may form. Stolz saw complete union of fracture of the os suffraginis follow the employment of his ointment dressing (see "Fractures of the Metacarpus"). Cold-water applications are usually of little value, and have the positive disadvantage of softening the skin and favouring excoriation by the bandage.

Fractures of the os coronæ are similarly treated, but, as bandaging is here of less value, one is often confined to merely resting the animal. Excessive pain may be reduced by cold baths or applications. Stripping the sole, formerly practised in such cases in France, is to be carefully avoided, as inflammation and suppuration are thereby greatly favoured.

The lameness which sometimes follows fracture of the phalanges may be removed by neurectomy of the median and external plantar nerves, and the animal thus rendered useful for a time.

In slinging animals in the above and other conditions, the following points should be borne in mind. The slings serve principally to prevent the animal lying down and temporarily to support it in painful conditions like lameness; but as in severe lameness of one limb the opposite limb is continuously loaded, laminitis, or sinking of the fetlock, unfortunately sometimes occurs, and it is therefore better when the animals are in good condition, and able to lie down without danger to the injured part, to favour this by giving plenty of straw and abstaining from the use of slings. Many practitioners

prefer pine sawdust to straw as a bedding in these cases. It is clean, gives a secure foothold, does not entangle the legs like straw, and when fresh is slightly antiseptic.

Sinking of the fetlock, and laminitis with displacement of the pedal bone may be recognised by deformity of the fetlock and by pain and increased pulsation in the plantar arteries. Immediately these symptoms are seen the patient should be removed from the slings, provided with a soft bed and allowed to lie down.

III.—FRACTURES OF THE SESAMOID BONES.

THESE fractures have repeatedly been seen in horses. Williams found the sesamoid bones broken in several pieces after galloping in deep sand. Howell saw one of the sesamoid bones broken into five portions under similar circumstances. Transverse fracture has also been seen. As it is produced by the pull of the upper and lower sesamoidean ligaments, this method of fracture appears very natural. Rutherford saw a horse which after making a few bounds went very lame; the sesamoid bones of all four feet were afterwards found transversely fractured. Möller has several times seen fracture of the sesamoid bones accompanied by tearing of the suspensory ligament. Partial rupture of the suspensory ligament, with fracture of larger or smaller portions of the sesamoid bones, is seen in race-horses. Cadiot is of opinion that the sesamoid bones of the fore limb may be fractured by a direct blow from the toe of the hind foot. Such an accident seems possible, but Cadiot's suggestion would not explain bilateral fracture, still less fracture in hind limbs.

Möller witnessed fracture of both sesamoid bones and partial rupture of the suspensory and inferior sesamoidean ligaments in a working-horse which had been kept in the stable for some weeks on account of lameness. Schöneck describes a similar case in a Russian trotting-horse. A cart-horse, which had been rested for a long time on account of disease of the tendons, suddenly fell in the street the first time of going to work, and could not be got up. On post-mortem, the sesamoid bones of both fore limbs were found horizontally fractured, and in each of the hind feet the flexor pedis perforans tendon was torn away from its point of insertion into the os pedis.

Continued rest appears to cause change both in bones and tendons; the view that such accidents are solely caused by the animal capering about is scarcely defensible.

The symptoms are generally pronounced. In horizontal fractures the fragments are drawn apart and the fetlock-joint sinks a little

towards the ground, being no longer supported by its suspensory ligament, but so long as the flexor tendons are intact the fetlock does not reach the ground. The accident is distinguished from rupture of the flexor pedis perforans by the normal position of the hoof, the toe of which, in rupture of the tendon, is directed upwards, so that it no longer touches the ground. In fractured sesamoid there is excessive lameness, swelling, pain on pressure over the fractured bone and sometimes slight crepitation. In perfectly fresh fractures a depression may be felt between the pieces of bone.

The prognosis is unfavourable. Reposition and retention of the broken parts are scarcely possible, the sharp edges of the fragments may injure the articular surface of the metacarpus and wound the flexor tendons, and callus formation is usually large and disfiguring, frequently limiting flexion of the joint.

Möller unsuccessfully treated a race-horse for several months, and found on post-mortem examination that the broken pieces had not united, and that the condition was substantially as above described. Field claims to have seen recovery follow longitudinal fracture of both sesamoid bones. On account of the great pain accompanying fracture, excessive volar (upright pastern) or dorsal flexion (oblique pastern) may later result. The first occurs when pain is great and the limb is rested for a long time; in other cases, as when pain is slight and weight is placed on the foot during recovery, excessive dorsal flexion results. Restoration of normal position and of usefulness being very rare, treatment is only justifiable in valuable breeding animals.

Treatment. If treatment is to be attempted, the fetlock-joint must be fixed in a position of moderate volar flexion by a plaster or strong linen bandage; a special shoe furnished with a ground pillar to support the fetlock may be required. Complete rest is necessary. Light horses, which have no difficulty in lying down and rising, do best on a soft bed; other patients must be slung.

IV.—SESAMOID LAMENESS.

IN solipeds, both the anterior articular surface of the sesamoid bones in contact with the metacarpus and the posterior surface over which the flexor tendons glide are often the seat of acute or chronic inflammation. Brauell, in 1845, first drew attention to inflammation of the posterior surface, and pointed out that it was similar in character to that of chronic navicular disease. Ten years later

Mascher described the disease, for which Günther introduced the name sesamoid lameness. Schrader afterwards gave a thorough pathological and anatomical description of it. Acute inflammation of the posterior gliding surface of the sesamoid bones sometimes occurs in consequence of acute tendovaginitis of the flexor sheath.



FIG. 512.—The flexor pedis perforans tendon in a case of sesamoid lameness; at the point where it passes over the sesamoid bones the perforans tendon is fibrillated (after Brauell).

James states having found an abscess about the size of a walnut (?) in the sesamoid bones (?) of a draught-horse. It was supposed to have been caused by injury, and was accompanied by acute inflammation of the tendon sheath. Probably the condition was purulent tendovaginitis. In two horses treated for local necrosis of the skin of the hind limbs, suppuration occurred in the flexor tendon sheath, with rupture of the perforans tendon. Post-mortem examination showed necrosis of the tendon, of the posterior surface of the sesamoid bones, and of the navicular bone. The process had extended downwards in the track of the tendons, and had attacked the navicular bursa.

Pathological anatomy. Changes characteristic of arthritis chronica are found affecting the gliding surface of one or both sesamoid bones; the cartilage becomes eroded, and its margins proliferate. When the anterior surface is diseased, both it and the posterior articular surface of the metacarpus exhibit abraded and eroded spots. In disease of the posterior surface of the sesamoid bones, the flexor tendons appear roughened and fibrillated (Fig. 512), or sometimes partially ruptured. Brauell saw a few cases of adhesion of the flexor tendon to the sesamoid bones. The sides of the bones showed osseous deposits. The tendon sheath and sesamoid ligaments were thickened; in some cases detached pieces of bone were found in the sheath. In the cases reported by Levens, the sesamoid bones had probably been fractured.

As a rule, both sesamoid bones are affected; Mascher, however, found disease of a single sesamoid and of the corresponding metacarpal articular surface.

Causes. Any violent strain of the supporting apparatus or increase of the pressure normally exerted by the flexor tendons on the sesamoid bones may produce this disease, and therefore both Brauell and Mascher regard long, weak fetlocks as the chief predisposing factor. This formation not only throws a greater strain on the tendons, but increases the pressure on the sesamoid bones, on account of the more oblique angle which the tendons make with the

metacarpus. This probably explains Mascher's statement that where the toes are turned in, the outer sesamoid is affected, and *vice versa*, for such defective conformation must necessarily lead to unequal pressure on the sesamoid bones. Heavy bodies and weak fetlocks predispose to the disease, which is commonest in "weedy" hacks and hunters, and in draught-horses with long, sloping pasterns, and occurs principally in the fore limbs. Other causes are jumping, especially from a height, and suddenly reining up. In such cases, partial rupture of the flexor tendons probably occurs and starts the disease; Siedamgrotzky reports an observation of the kind. The disease may then set in with acute inflammation, but as a rule it develops slowly, the flexor sheath being often simultaneously affected at a point close to the fetlock-joint.

Symptoms. In the chronic form, lameness is a constant symptom. As in all affections of the flexors, pain is greatest when weight is placed on the limb. The phalanges are flexed and the limb is rested. Volar flexion is in most cases well marked. Lameness is most distinct during the first few steps, but may disappear with exercise; it is decreased by long rest, increased by exertion, is more marked on rough, hard ground than on sand or grass, and is sometimes so slight as only to be detected by carefully watching the animal whilst trotting, though in severe cases it is apparent at a walk.

Manipulation of the back of the fetlock gives pain. After some time the sesamoid bones become enlarged. If the anterior surface of the sesamoids is involved, the enlargement is close to the metacarpus, *i.e.*, at the side of the joint; in disease of the posterior surface it is further back on the volar aspect of the joint. After a further variable period the flexor tendons become swollen in the neighbourhood of the sesamoid bones, though such swelling may occasionally appear before the other symptoms. The acute form is distinguished by local heat, &c., which is absent in chronic cases. During the later stages there is "knuckling" at the fetlock-joint, from thickening of the tendons. In one case Brauell found the sesamoids, in consequence of the marked volar flexion, thrust upwards beyond the articular surface of the metacarpus and adherent in their new position. Movement of the fetlock-joint is often distinctly limited. Crepitation can rarely be detected.

The course is chronic, inflammation seldom subsiding, but continuing for long periods and necessitating neurectomy or slaughter. Lameness becomes worse after severe exertion, but tends to disappear with rest. Complete recovery is, however, very rare once the disease has become well developed.

Diagnosis is seldom difficult, the condition of the sesamoids and the character of the lameness being often sufficient to form an opinion, provided no other disease of the limb exists. Exostoses sometimes occur on the sesamoid bones, particularly on their lateral surfaces, without causing a trace of lameness, and, from their symmetrical appearance in both limbs, often give the impression of being congenital. Before delivering a prognosis, it is advisable thoroughly to examine the flexor tendons, and to make sure whether the fetlock-joint can be fully flexed.

Treatment. During the stage of acute inflammation, and particularly when the flexor tendons exhibit recent swelling, the animal should be rested, and the fetlock-joint, as far as possible, fixed by a firmly applied bandage, moistened with warm water, or, in case of great pain, with a continual current of cold water. Good results sometimes follow firing and blistering, though six to eight weeks' rest is then necessary. Old-standing cases are not often benefited by such treatment. Neurectomy is the only means of permanently removing lameness; and, considering the seat of disease, it is better to divide the median than the plantar nerve.

V.—RING-BONE.

THE term "ring-bone" has been used since olden time to indicate many chronic diseases about the coronary joint attended with enlargement. At first such enlargements were regarded as resulting from a single cause, but careful anatomical examination shows that they may be due to very different disease processes. The following forms of ring-bone have been differentiated:—

(1) Articular ring-bone. This consists in an arthritis chronica. Sometimes it consists of an arthritis chronica deformans in which the articular cartilage forms the point of origin of the disease, sometimes it follows synovitis. The articular cartilage of the os suffraginis or os coronæ is found to be more or less altered, according to the age of the disease, whilst exostoses occur on the borders of the joint (Fig. 497). We, therefore, have to deal with an arthritis sicca vel deformans. In the later stages the suffraginis and coronet bones become covered with extensive ossific deposits, whilst the articular cartilage is totally destroyed; obliteration of the joint (synarthrosis) may even occur, as shown by numerous reported cases.

(2) Periarticular ring-bone. In consequence of chronic periarthritides produced by displacement, or by continued strains on the limiting apparatus of the joint, thickening occurs, particularly

at the points of insertion of the lateral ligaments, and produces swellings on the inner or outer side of the joint. Post-mortem examination shows the articular surface to be healthy, but the ligamentous apparatus is thickened, and more or less well-developed exostoses exist at the points of insertion of the lateral ligaments, though they also occur at the spot where the posterior ligaments of the coronet-joint become attached to the suffraginis. As the articular cartilage is free from disease, this condition has by some been named false ring-bone.

(3) Rachitic ring-bone. In young animals suffering from rachitis,



FIG. 496.—Articular ring-bone.



FIG. 497.—Periarticular ring-bone.

thickenings sometimes persist on the lower extremity of the suffraginis and at the upper extremity of the coronet bones, and, as they cause swelling around the joint, have been described as ring-bones. In such cases, however, there is no pathological change either in the joint proper or in its ligaments.

(4) The term "traumatic ring-bone" includes all enlargements about the coronary joint produced by periostitis due to other (usually traumatic) causes, whether following treads on the coronet or acute inflammatory disease of neighbouring parts, wounds, &c. This classification meets practical requirements, for, in clinical diagnosis, it is quite possible to distinguish the different forms, and to modify the prognosis according to circumstances.

Causes. The cause of the coronet-joint being so frequently the

seat of disease lies in its anatomical formation. To act as an incomplete ginglymoid joint, its area must necessarily be limited, and its articular surface flat. This, however, favours strain of the ligaments and unequal distribution of weight over the articular surface, circumstances which lie at the root of the morbid changes, while they also explain why the periarticular form of ring-bone is the most frequent, and why the disease only occurs in solipeds.

Considering the varied forms of ring-bone, it is not surprising that equal variety exists in the immediate causes. The existence of the disease in two or more feet suggests hereditary predisposition,

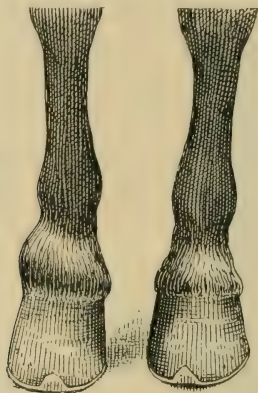


FIG. 498.—The outside of the right coronet shows ring-bone formation; the left is normal.

and may often be traced to small and badly-shaped joints, or defects in the formation of the limbs. The greater weight borne by the front limbs explains their so frequently becoming diseased. Turning the toes in or out causes unequal distribution of weight in joints and strain of ligaments, and therefore often produces periarticular ring-bone. Such conformation being perpetuated in the progeny, renders it easy to understand why the disease is often inherited. Havemann drew attention to this, and condemned the use of animals with ring-bone for breeding. There seems no reason for believing that coarse-bred animals suffer oftener than others; but if the statement be true, the fact is probably due, in part at least, to the less care taken in selecting mares for breeding.

Both Peters and Williams state that ring-bones are commonest in animals with long, weak pasterns, and refer this to the greater strain

on the ligaments. Peters says the process begins at the middle of the dorsal or anterior surface of the joint as an inflammation of the capsular ligament. Percival believes, on the other hand, that upright pasterns favour formation of ring-bones, because of the greater shock to which the bones are subject in moving. The abnormal formation above noted is, however, of more importance. The predisposition to ring-bone in young animals is a result of the greater vulnerability of the bones and joints.

The external causes are sprains and all influences favouring sprain, such as defective formation of the limb, unequal paring of the hoof, using young animals at a rapid pace and on rough ground. Unskilful shoeing plays an important part. If one side of the foot-wall is left higher than the other, that side will first come in contact with the ground, the weight will be distributed unequally in the joints, and the external ligaments of the opposite side may be strained. The "camber" of modern roads acts in the same way. Low heels and long toes are almost always active causes. Heavy horses in mounting hills bring about a similar condition of things; the leverage of the toe becomes greater. If the general direction of the phalanges (phalangeal axis) be not parallel with that of the walls of the hoof (hoof axis), but more upright, there is danger of straining, not only the different portions of the inferior sesamoid ligaments and the lateral ligaments, but the tendon of the flexor pedis also. Such strain also results when the heels of the shoes become worn down; and animals with upright pasterns and narrow heels seem particularly predisposed. Gutenäcker has recently studied it carefully, and has found osteophytes at the points of insertion of the ligaments into the os suffraginis. The causes of rachitic ring-bone are little understood, and the same is true of the reported cases of ring-bone following strangles, and its greater frequency in certain breeds. It has not yet been shown that it is due to deficiency of calcium salts. Traumatic ring-bone is produced by inflammation extending from neighbouring parts to the periosteum.

Symptoms. The common basis of these conditions is chronic enlargement around the coronet-joint, which is sometimes so slight as only to be detected by careful examination and comparison of the two pasterns. In such cases, of course, the limbs must be placed as nearly as possible in similar positions. Exostoses on the lateral surfaces of the bones are best seen from the front; those on the anterior surface from the side, and from the height of the affected foot. Diagnosis is also assisted by palpation and comparison of the two joints.

In articular ring-bone the exostosis extends from either side over the anterior surface of the joint, and appears more or less circular, from which circumstance it has received its name. The posterior surface is covered by the ligaments and flexor tendons, and therefore cannot well be examined. The exostosis sometimes arises chiefly from the suffraginis, and is then rather high placed, sometimes from the os coronæ, or os pedis, when it is found either just above or within the hoof. High and low forms of ring-bone have therefore been distinguished. The swelling is hard, painless on pressure, and the skin covering it is movable.

The periarticular form is similar in appearance, except that the enlargement is usually confined to the lateral surfaces of the suffraginis and coronet bones, and the anterior surface is usually normal. As in the former case, the swelling may appear higher or lower, and in general what has been said above also applies to this form.

Lameness is a constant feature of articular ring-bone, and often accompanies the periarticular form. It occurs principally when weight is placed on the limb, and is sometimes considerable, sometimes only slight. Lameness may be absent in rachitic ring-bone; and usually in simple exostosis on the pastern there is no sign of lameness. After a long rest it may partly disappear, and in spirited animals slight lameness is often lost during movement. When the condition has become chronic, the muscles of the limb atrophy, wasting being proportioned to the chronicity and severity of the lameness. As a rule the later phase of the stride is considerably shortened, and the phalanges show volar flexion, *i.e.*, the fetlock is upright. In the periarticular form, lameness is best seen when the animal turns in short circles towards the diseased side. It is a consequence of inflammation of the articular surfaces or of ligaments, though at times it results from mechanical obstruction to movement in the coronary joint, due either to the formation of exostoses or to thickening of ligaments, and adhesions around the articular surfaces. Such adhesions are often accompanied by excessive volar flexion. By lifting the foot the ankylosis of the joint is discovered immediately an attempt is made to rotate, to flex, or to extend it. From the above it will be clear that the degree of lameness in no way depends on the size of the exostosis; a large exostosis may only produce slight lameness, and *vice versa*.

The diagnosis of ring-bone is very difficult unless the enlargement is well developed. In foals the phalangeal epiphyses appear well developed, and the coronet-joint lies high in consequence of incomplete

development of the hoof. The proper distribution of weight on all four feet and the absence of lameness show this condition to be normal. Thickening of the skin may be recognised by palpation, and ossification of the lateral cartilage can easily be distinguished from ring-bone if palpation is practised with any approach to care.

It is more difficult to distinguish ring-bone from synovitis of the coronary-joint, though the latter is accompanied by acute inflammatory symptoms (increased warmth and pain on pressure). As, however, chronic disease consequent on strain also falls under the designation ring-bone, conditions occur which may be described by either term. The disease may be masked by thickening of the skin around the joint, a condition sometimes induced for purposes of deception; the trick succeeding the more readily as laymen are predisposed to refer lameness to the skin injury. It is always safer to take the opposite view.

Course and prognosis. As a rule, the disease is chronic, though the different forms of ring-bone exhibit many peculiarities. The articular form generally sets in slowly, though at times it results from acute synovitis, and is then described as arthritis. As complete recovery cannot be expected, the prognosis depends on the degree of lameness and the work required of the horse. Lameness of sufficient severity to prevent work can only be removed by neurectomy. Exostoses, involving the front of the joint, offer little chance of cure, and those fixing the joint none at all.

Periarticular ring-bone sometimes results from periarthrititis of the coronet-joint, or from repeated strain of its lateral ligaments. Improvement or cure depends on the nature of the pathological processes, and the possibility of removing the active cause. When the joint is much enlarged and the position of the pastern altered, recovery is not to be expected. The more nearly the enlargement approaches the joint, especially the front or back of the joint, and the nearer it is to the hoof, the more serious the condition; high ring-bones are therefore less dangerous than those in the coronet region. The prognosis is also less hopeful where conformation is bad. When, on the other hand, errors in shoeing, such as unequal paring of the foot, are the cause, their removal will be followed by diminution or disappearance of lameness, but the exostoses are never completely removed. The prognosis is naturally unfavourable in ankylosis of the joint. The rachitic form always develops slowly, and is permanent, though it seldom causes lameness; if lameness exists, it may safely be ascribed to other changes, which must therefore be considered in delivering a prognosis.

Traumatic ring-bone, consequent on local inflammation near the coronet-joint, only causes lameness in the early stages, and as a rule this afterwards disappears, but large exostoses near the joint may produce permanent lameness.

Needless to say the prospect is less hopeful in saddle-horses than in ordinary working-horses, though animals with large ring-bones have been known to give satisfaction in fast work. Special care is required in young patients, particularly if ring-bone develop before the animal has done much work. If, under such circumstances, the lameness is obstinate, there is little prospect of the animal ever proving useful. On the other hand, old horses which have shown ring-bones for a long time without going lame are likely to continue sound, unless exceptionally severe work is demanded of them. It is common experience that ring-bones in hind feet less frequently cause lameness than those in front.

Treatment. Ring-bone can be prevented by care in the selection of breeding animals, by proper use and treatment of the young animal, by careful paring of the hoof, and later by proper shoeing. In the articular form, nothing whatever is gained by ordinary treatment; neurectomy alone is likely to remove lameness, but even it fails when the joint has become fixed.

In periarticular ring-bone attention must be directed to preventing sprains and to securing a proper distribution of pressure in the articulations. The hoof should be carefully pared to allow the weight to be distributed regularly in the coronet-joint, and to avoid strain of its ligaments. The parts of the wall which first meet the ground when moving should, therefore, be shortened. Though attention must be directed to the side of the wall, yet the bearing of the toe should not be overlooked. Over-long heels should be shortened; some practitioners recommend plain shoes (*i.e.*, without calkins), thin at the heels; or, if the heels be too low, a shoe with calkins, or better with thick heels. As a rule, it is sufficient properly to pare the foot. Care must be taken that the pastern lies parallel with the walls of the hoof; if not, it must be caused to do so. This is necessary on two grounds: firstly, because the position of the pastern is often changed in the disease in question; secondly, because such change in position may lead to sprains of the ligaments of the joint. Observance of these precautions is of far greater value than any local treatment. In this way Möller often cured old-standing lameness, which had resisted every other method of treatment attempted.

As long as inflammation of the ligaments or periosteum con-

tinues, stimulation of the skin may be successful. Cantharides and biniodide of mercury ointments, &c., are of little value unless rest is given. When possible, the patient should be rested for four to six weeks. Failing success by these methods, firing may sometimes be successfully resorted to. Puncture firing in two or three rows is most efficacious. Sometimes a few punctures over the swelling are sufficient. Of late years deep (needle)-firing has come to be regarded as the most efficient means of dealing with ring-bone. Deep firing has been recommended in France, but care must be taken not to open the joint. For firing Dollar uses and strongly recommends Graillot's zoö-cautery, or Déchery's automatic cautery with fine points. Periosteotomy has been suggested, but is of no real value.

If after such treatment lameness continues, or if the animals are of little value, and long-continued treatment is objected to on the score of expense, neurectomy may be tried. As a rule, the plantar, digital, or median nerve must be divided, and the operation is generally successful unless mechanical obstruction to the movement of the joint exists.

As the treatment of chronic ring-bone often calls for every remedy in the *répertoire* of the practitioner, and as the various neurectomies usually represent his

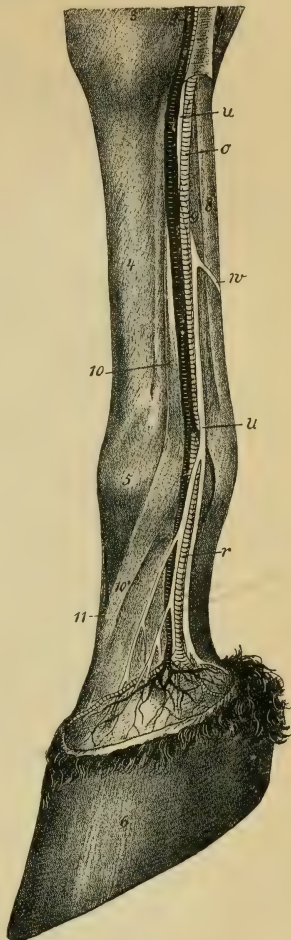


FIG. 499.—*u*, Internal plantar nerve, which, below the fetlock, divides into the anterior, middle, and posterior digital nerves; *n*, oblique branch from internal to external plantar nerve; *o*, large metacarpal artery; *r*, digital artery; *y*, internal metacarpal vein, which, below the fetlock, is represented by the digital vein.

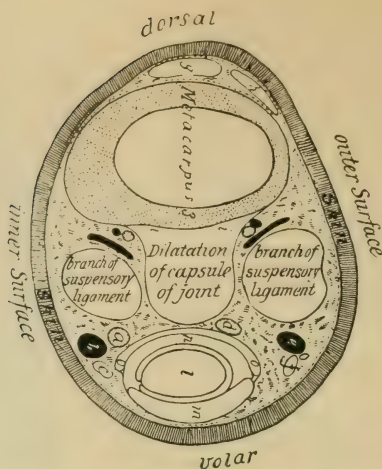


FIG. 500.—Section through the metacarpus about 3 to 4 inches above the fetlock-joint. *a*, Digital artery; *b*, digital vein; *c*, digital nerve; *l*, flexor pedis perforans tendon; *m*, flexor pedis perforatus tendon; *o*, tendon sheath.

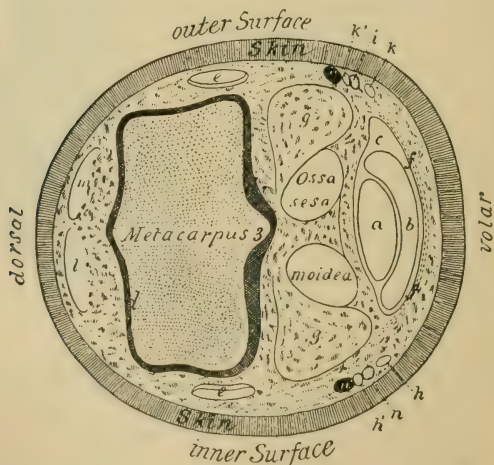


FIG. 501.—Section through the fetlock-joint. *a*, Flexor pedis perforans tendon; *b*, flexor pedis perforatus tendon; *c*, tendon sheath; *d*, capsule of the fetlock-joint; *h* and *h'*, *k* and *k'*, branches of the posterior digital nerves; *i*, *n*, digital arteries.

last resource, those more commonly performed will be described at this place.

Before utilising any of these operations, however, it is necessary clearly to ascertain two points—viz. : (1) That the diseased and painful parts are exclusively supplied with sensory fibres by the nerve to be divided ; and (2) that the lameness is due solely to pain and not to such changes as adhesions in or around the joints themselves or contraction of tendons or ligaments. If these conditions can be satisfied the lameness will be removed by neurectomy, but

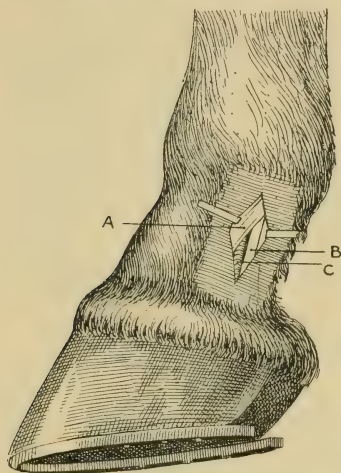


FIG. 502.—Neurectomy below the fetlock. A, Ligament of the ergot ; B, digital nerve ; C, digital artery.

not otherwise. Needless to say, it is unwise to operate on riding-horses, especially when the front limbs are placed far under the body and the pasterns are upright ; such animals are prone to falls under any circumstances, and to deprive them of sensation in the lower part of the limb is calculated to aggravate the defect.

Plantar neurectomy. This operation may be performed at one of several points : one to two inches above the sesamoid bone, where the nerve lies immediately in front of the flexor tendons ; on the lateral surface of the fetlock-joint, or, again, an inch or so below the sesamoid bone and behind the fibrous band which extends from the plantar cushion to the ergot. Resection of the nerves at or above the fetlock is known as high plantar neurectomy, while

resection of the posterior division of the digital nerve is termed low plantar, or digital neurectomy. The high operation is generally preferred, though the low or partial operation is very useful where the cause of the chronic lameness is confined to the posterior region of the foot. In certain cases neurectomy may be restricted to one side of the limb. When resection is performed on both plantar nerves, the incision on the inner side of the leg is usually made a

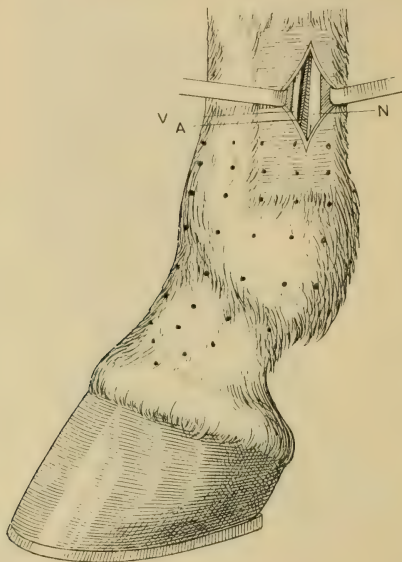


FIG. 503.—Neurectomy above the fetlock. V, Vein ; A, artery ; N, nerve.

little above the prominence of the fetlock-joint, so that the wound may not be injured by the opposite foot.

The animal is cast and anæsthetised, the limb to be operated on is released and drawn forwards, the skin shaved at the seat of operation, and the parts cleansed and disinfected. To prevent troublesome bleeding it is very convenient to apply a rubber bandage from the fetlock to the knee and to pass a stout rubber cord tightly round the limb just above the knee itself ; the bandage is then removed, leaving the parts practically bloodless and partly anæsthetic.

The operation is usually performed first on the inner side, as the wound can then be better guarded against soiling than in the opposite

case. By observing antiseptics primary union can be obtained. After ascertaining the position of the nerve by palpation an incision about an inch long is made directly over it. The nerve is readily recognised by its fibrous appearance and lighter colour. Any trifling bleeding is checked with tampons of cotton-wool and the nerve freed from surrounding tissues with a few touches of the knife. A thread is then drawn under the nerve with the tenaculum, and a portion of the nerve about an inch long is freed and then divided at the upper angle of the wound, with knife or scissors. The animal, if not anæsthetised, usually struggles at this stage. Division of the lower part of the nerve is unattended with pain. Blood is removed with tampons of cotton-wool and the parts cleansed, if necessary, with sublimate or carbolic solution. The skin is brought together with one or two interrupted silk sutures and the parts covered with iodoform collodion, wound gelatine, or a small cotton-wool dressing.

The operation on the outside of the limb is performed in a precisely similar manner, the point of incision only differing. The nerve can readily be discovered at the point where it passes with the digital artery over the fetlock-joint as a small hard cord which rolls under the finger. Figures 499 to 503 clearly show the position.

The wound usually heals in five to eight days, provided antiseptics has been observed and the incisions skilfully made. It is best, if possible, to avoid washing out the wound with disinfectants, as the tissues are thereby irritated and healing is retarded. In a word, asepsis is preferable to antiseptics.

Neurectomy can be performed without casting by injecting 20 to 40 minims of a 10 per cent. solution of cocaine into the subcutis immediately within the area of operation. By applying an Esmarch bandage and rubber cord the operation can be performed without bleeding. The horse's foot can be placed on a farrier's shoeing block so as to bring it to a convenient height for operation.

Sometimes the horse becomes sound immediately after operation, sometimes lameness only disappears by degrees. In other cases improvement is effected, but the animal does not become sound. Such cases are usually due to recurrent sensibility, or to mechanical interference by bony growths with the play of the joints. The horse should be rested for several weeks or closely watched, in order to note any possible signs of degeneration in the tendons or inflammatory changes in the foot.

Nocard has shown that the uprightness of the foot often diminishes and the size of the bony growths becomes less after plantar neurectomy.

Median neurectomy. The median nerve is readily discovered on the inner surface of the fore-arm running obliquely downwards and slightly backwards just behind a ridge on the head of the radius, into which is inserted the internal lateral ligament of the elbow. It crosses the posterior radial artery at a very acute angle, and passes

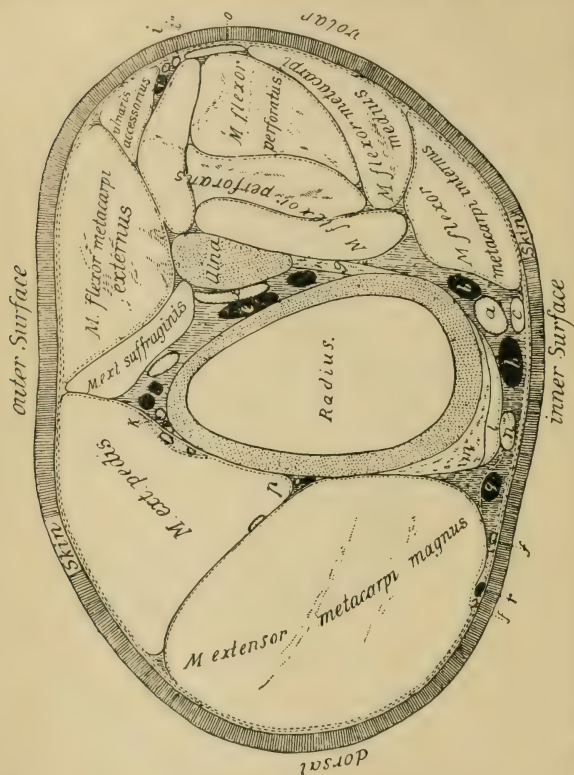


Fig. 504.—Section through the fore-arm, near the bottom of the upper fourth of the radius.
a, Radial artery; *bb*, radial veins; *c*, median nerve; *d*, interosseous artery; *e*, interosseous vein; *f*, ulnar artery; *g*, ulnar vein; *h*, ulnar nerve.

with it towards the posterior surface of the radius. The posterior radial vein (or veins) is situated in front of the nerve. The operation is performed (under general or local anæsthesia) opposite the lower portion of the elbow-joint, or immediately behind the ridge on the inner border of the radius towards the upper point in the depression between the radius and the internal flexor muscle of the knee.

The skin having been shaved and disinfected, the limb is drawn

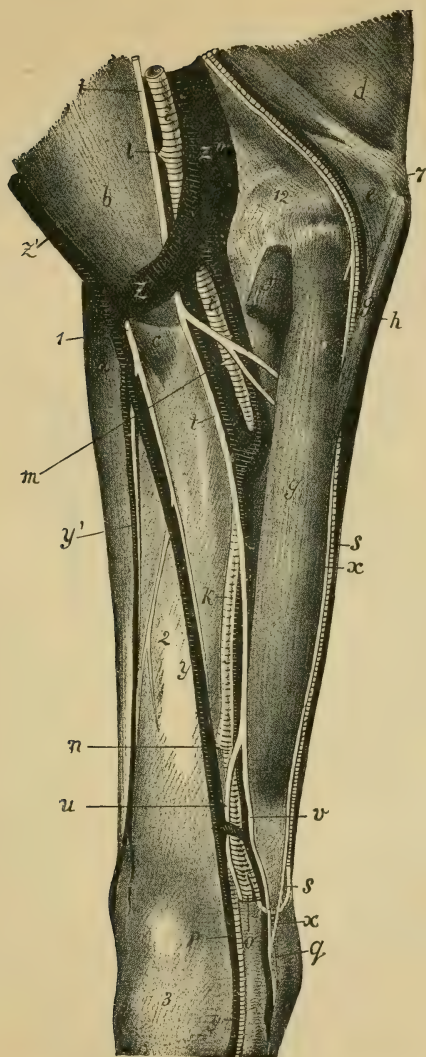


FIG. 505.—*k*, Radial artery ; *s*, ulnar artery ; *t*, median nerve ; *x*, ulnar nerve.

well forward and an incision about an inch and a half in length is made, traversing successively the skin, subcutaneous connective tissue, and the prolongation of the superficial pectoral muscle. Any bleeding vessels are carefully closed with Wells' forceps, and the seat of operation is cleared of blood. The operator then assures himself by palpation that the nerve lies in or near the middle of the incision. Should this not be the case, the limb is moved slightly forwards or backwards until the nerve is brought into the desired position. Towards the lower angle of the wound the fascia of the fore-arm is slightly incised, a grooved director passed under it and pushed upwards, parallel with the nerve. By passing the bistoury along the groove the fascia is then laid open. Another method consists in using a

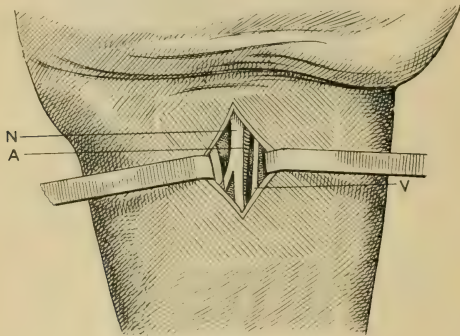


FIG. 506.—Median neurectomy (semi-diagrammatic). N, Median nerve ; A, posterior radial artery ; V, one of the post-radial veins.

probe-pointed bistoury. Certain operators even snip away with scissors an elliptical piece of fascia on either side, thus more fully exposing the nerve. The skin wound is then held open with retractors. The next step consists in dissecting free the nerve, which is often surrounded with fibro-fatty tissues, and raising it on the director or tenaculum. The nerve is cut through as high up as possible, and again near the lower limit of the wound, a piece about an inch in length being removed. The operation is concluded by disinfecting the wound, dusting with iodoform, suturing the skin and applying a little iodoform collodion or similar dressing.

When the incision is made at the proper point, and the anti-brachial aponeurosis opened, the nerve often appears immediately as a flattened whitish cord, which has a tendency to become thrust

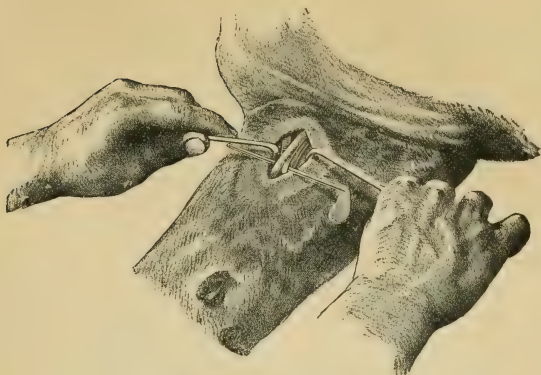


FIG. 507.—Operation of median neurectomy. The nerve exposed.



FIG. 508.—Section of "amputation fibroma" from the divided end of the median nerve, three months after operation.



FIG. 509.—Longitudinal section of the median nerve, 6 inches below the point at which neurectomy was performed. The remains of the nerve bundles contain the degenerated myelin cylinders (stained black). The loose connective tissue surrounding the divided nerves contains fat, as indicated by the smaller black dots.

forward and to protrude between the lips of the incision in the aponeurosis. When the nerve does not appear, it is usually sufficient slightly to alter the position of the limb. The most serious difficulty to be feared is from injury to the veins in this neighbourhood, and every care must be taken to avoid such a complication.

Peters, and after him others, showed that division of the median nerve alone may remove lameness resulting from bilateral lesions—that is to say, occupying both sides of one of the lower parts of the leg, or encircling these regions. The results are explained by the preponderating influence of the median nerve in the innervation of structures below the knee, a preponderance due to the fact that at a variable point in the fore-arm the nerve terminates by dividing into two branches, one of which is continued as the internal plantar nerve, while the other joins the ulnar and is continued as the external plantar nerve.

Cadiot and others have seen horses in which lameness, arising from various chronic affections (strained tendons, splints and ring-bones), has been removed, or certainly diminished, by resection of the median nerve. But cases occur in which section of the median fails to remove lameness caused by lesions on the outer side of the limb, or at times even on the inner. The persistence of pain and lameness in the latter case may sometimes be explained by the existence of recurrent fibres. Under such circumstances, ulnar, or external plantar neurectomy may prove useful.

Ulnar neurectomy. Throughout the whole extent of the fore-arm the ulnar nerve, accompanied by the ulnar artery and vein, is situate between the oblique and external flexors of the metacarpus, and under the fascia uniting them. By palpation with the finger tips the muscular interspace which indicates the line of incision is readily discovered.

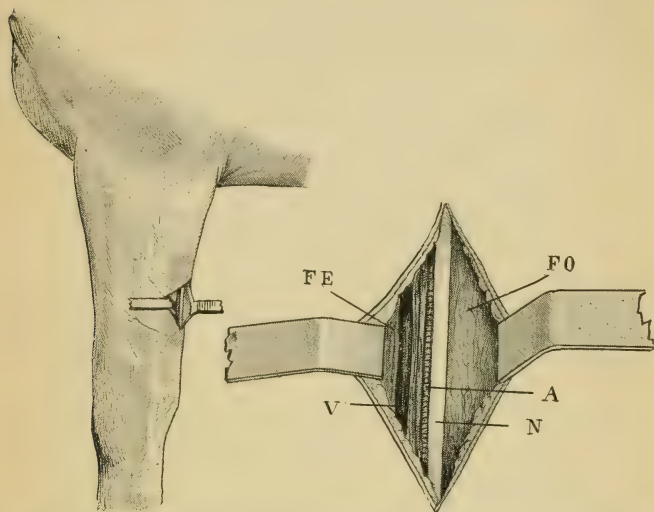
In performing this operation the horse is cast on the sound side. The affected limb is left in the hobbles, but held extended by means of two strips of webbing, one fixed on the upper portion of the cannon bone being pulled backwards, the other, attached to the coronet, in a forward direction. Two assistants, holding the free ends, keep the parts steady. The operator kneels in front of the upper part of the fore-arm; the point selected is about four inches above the pisiform bone. The parts having been prepared, he makes at the point just indicated an incision about 1 to 1½ inches long through the skin, subcutaneous connective tissue, and the fascia which unites the aponeurotic covering of the two muscles.

With forceps and bistoury the connective tissue surrounding the

nerve is dissected away, following the direction of the wound, and carefully avoiding injury to the ulnar artery and vein which accompany the nerve.

The nerve being isolated is divided at the upper angle of the wound, and a piece about an inch in length is excised. The wound is cleansed and the skin brought together with a few small sutures.

Neurectomy, double plantar, median with ulnar or external plantar, often has serious drawbacks. It should be reserved for *old-standing* chronic affections of the fore limb, and—particularly



FIGS. 510 AND 511.—Neurectomy of the ulnar nerve. FE, Flexor metacarpi externus; FO, flexor metacarpi obliquus; N, ulnar nerve; AV, ulnar artery and nerve.

in dealing with valuable animals—should not be tried until all other methods of treatment, especially firing, have proved unsuccessful.

Loss of the hoof, thickening of the subcutis, fracture of the navicular, or os pedis, and degeneration with rupture of the flexor tendons are not uncommon sequelæ; the first most frequently results when there are large exostoses on the front of the joint, near the coronet. Perhaps loss of the hoof is due to the coronary band being bruised between the exostosis and the hoof. To avoid this *contretemps*, the toe of the hoof should be freely pared, whilst the heels are preserved. If needful, shoes with thick heels or high calkins are applied.

Loss of the hoof also follows neglected corns, or pricks in shoeing; the injury not being detected owing to the animal showing no signs of lameness. But in the majority of cases, unnerved horses continue serviceable for a year to two years or even longer, according to the nature of the disease for which the operation was performed. In some cases neurectomy may be performed twice, at an interval of 18 months to two years, and the subjects may work satisfactorily for a further period of two years or longer, but very few horses remain long useful after a third operation. Recurrence of lameness may be due to compression of the central end of the resected nerve, to re-establishment of sensation in the primary seat of disease, or to some cause existing above the point of operation. The first arises from growth of new connective tissue ("amputation fibroma," or "neuroma") around the stump of the nerve, and the lameness can be removed by excision of the fibrous growth, or by resecting the nerve above the enlargement.

VI.—SPRAIN OF THE CORONARY JOINT.

WHILST luxations of the phalanges are rare, sprain is more common, particularly in the coronet-joint. It occurs either from excessive dorsal or volar flexion or forced lateral movement in the joint, caused generally by slipping to the side, and consists in violent stretching, sometimes in partial rupture of the ligaments.

Such accidents are favoured by—

(1) Defective formation of the joints. Small articular surfaces offer less secure support, and are generally furnished with weak ligaments. This is particularly true of joints which appear narrow when seen from in front.

(2) Faulty position of the limb. The most important of such faults is turning the toes outward or inward. If the axes of the joints are not perpendicularly under the centre of gravity, unequal stress must be thrown on the ligaments every time weight falls on the limb; in addition, unequal weight being thrown on the inner and outer portions of the joints, the gait becomes insecure.

(3) Narrow hoofs and excessive lowering of the wall. Where one side of the wall comes in contact with the ground sooner than the other, the load is unevenly distributed, and the lateral ligaments are apt to suffer. Horses which have worked for a long time under such conditions generally show excessive lengthening of the ligaments, best recognised in a position of volar flexion. The immediate causes of sprain are slips, falls, or injuries sustained in rising. Such accidents

are favoured by irregular pavement, high calkins or heels, narrowness of the chest, and lameness. The condition is therefore commonest in large cities, and during the winter. Less frequently the foot is caught in deep ground, or between fixed objects like railway-metals. The commonest complications are fractures of the os coronæ; next to these come fractures of the suffraginis. The lateral ligaments of the coronet-joint are most exposed to sprain.

Symptoms. Lameness appears suddenly following a slip; the animal avoids placing weight on the limb, and movement is often painful. The foot is rested, and held in a position of volar flexion. Pain is evinced, both on passive rotation of the joint and when the animal is turned round. At a later stage, weight may be placed on the limb when the animal is in the stable or on level ground, though attempts to turn are followed by distinct recurrence of lameness. This is due to the fact that moving on level ground produces little tension in the articular ligaments. The affected part is warm and swollen, and there is often marked pain on pressure.

Careful examination of the separate joints usually reveals the position of injury, especially if the fetlock-joint be fixed and the coronet rotated, or *vice versâ*. Passive rotation of the fetlock-joint, however, does not produce so marked an effect as that of the two lower joints, because the form of its articular surface effectively limits movement. It is often difficult to discover whether the pedal or coronet joint is affected, but luckily the question is of no practical moment.

Course and results. Sprains and the inflammation resulting from them vary greatly in extent and intensity. A slight slip may produce violent momentary pain, in consequence of strain of the ligamentous apparatus, though such usually disappears with proper rest in twenty-four to forty-eight hours, when the condition may be regarded as cured. When sprain is complicated with rupture of ligaments, great pain is shown, and inflammatory symptoms (increased warmth and swelling) appear early. Slight cases completely recover within a period varying from a few days to several weeks, according to their gravity, but a disposition to fresh injury exists, which is directly proportional to the changes in the joint. Cases of extensive and intense inflammation of the joint, consequent on injury to ligaments (periarthrits), generally last four to six weeks, and may be followed by imperfect recovery or chronic lameness. In severe cases the diseased ligaments are apt to contract and impede free movement of the joint, which is also distorted. Excessive volar flexion may then occur, especially after inflammation of the

fetlock-joint. Limitation in the movement of the joint is shown by lameness, and by the upright position of the pastern. Inflammation of the ligament often extends to the bones, producing exostoses on the *os suffraginis* or *os coronæ*.

The synovial membrane may also be affected, causing distension of the cavity of the joint with inflammatory exudate (*hydrops articuli*). In other cases blood may pass into the joint (*hæmarthrosis*), producing on movement a peculiar sound which has been likened to that made by squeezing snow in the hands ("snowball sound").

Siedamgrotzky noticed in horses three cases of rupture of the lateral ligament of the hind fetlock, which recovered in three to eight weeks.

Percival made some anatomical researches on the production of articular diseases, and found the fetlock-joint ankylosed in five cases, the coronet-joint in forty cases, and the pedal-joint in sixteen cases. When implicating the coronet-joint, the condition is termed ring-bone (see section on that disease).

The rare occurrence of sprains in the fetlock-joint must be referred to the form of its articular surfaces which acts as an effective check on movement. Of the lower joints, the coronet suffers more frequently.

Prognosis depends on the extent and duration of injury. The degree of pain is generally a fair criterion of the mischief, though the early appearance of inflammation is more significant. The immediate pain which accompanies "treads" is of less importance than that due to strains. Although in the former cases pain may be so severe as to cause sweating and loss of appetite, it disappears almost as rapidly as its sets in, provided no grave complication arise. The delayed pain, due to inflammation, is of most importance in determining the prognosis; when appearing twelve to twenty-four hours after the accident it shows that grave injury has taken place, and if accompanied by marked fever is a grave symptom. The older the condition, the more slowly does resolution proceed. Hence the old rule: a sprain uncured in two weeks will require not less than four, and if then uncured will last at least a further four, and so on.

Treatment. The chief indication is perfect rest, but for large animals is unfortunately difficult to secure. All movement should be avoided, and the limb supported or fixed by firmly applying a strong linen bandage. During the first three days cooling applications keep down inflammation and modify pain, but after this time the only symptom justifying employment of cold is continued severe

pain. After the fourth day, absorbents like mercurial ointment generally act better. Warm moist applications are of the greatest service, and should be supplemented by pressure, which conduces alike to local rest and resorption. In many cases this treatment is sufficient. If, after diminution of inflammatory symptoms, severe swelling remain, the parts may be massaged with a mixture of equal parts of mercurial ointment and soft soap, and the patient exercised at a walk. If this prove unsuccessful, blisters of cantharides or sublimate may be applied; point or line firing is even better. In obstinate cases this treatment may with advantage be alternated, blisters being followed by moist warmth and methodical compression, which is especially useful for chronic thickening.

Rest is necessary in most cases throughout the treatment, and even to test his action the horse should not be trotted. To prevent further strains, the floor of the box should be flat and be covered with a layer of sawdust, shavings or peat. The bedding should be abundant, but if straw is used it should be cut into short lengths to prevent it winding round the animal's legs. When lameness disappears, the animal may be slowly exercised on soft ground and precautions taken against fresh slips.

The long-toed shoe, formerly recommended against "knuckling," should be carefully avoided on account of its aggravating any existing inflammation in the injured ligaments. Contraction is best combated by slow, cautious exercise during the period of convalescence.

The diseased joint may sometimes be fixed by a plaster bandage. In the fetlock the best application is a splint formed of several thicknesses of stout canvas sewn together.

As the coronet-joint can scarcely be fixed in this way, however, strict rest and the application of a blister may be substituted.

VII.—OSSIFICATION OF THE LATERAL CARTILAGE. SIDE-BONE.

THE term side-bone is applied to a condition in which the lateral cartilages of the foot become partially or entirely ossified. The wings of the pedal bone are prolonged backwards and upwards by two plates of cartilage about a quarter of an inch thick and approximately rhomboidal in shape, each of the faces being about three inches in length (see Figs. 513 and 514.) They are only found in solipeds. Under the action of the body-weight the plantar cushion, to which they are attached, alternately expands and contracts, and so long as the cartilages remain normal they respond to this movement. When ossification commences, however, movement in the anterior

portions is limited, and the posterior sections of the cartilage, which usually resist disease for the longest period, tend to be excessively displaced at each step. This aggravates the already existing inflammation in the anterior parts, and causes pressure on the sensitive structures of the back of the foot, sometimes producing lameness. For this reason the disease is often progressive, and is much more serious in animals with upright narrow heels, where the horn cannot yield, than in the opposite formation.

The entire cartilage does not always become ossified, however; nor do both cartilages of one foot or the cartilages of both feet always suffer at the same time.

Lungwitz, who examined 1,251 horses, states that side-bones occurred as shown in the annexed table:—

Description.	No. of Horses Examined.	No. affected with Side-bone.	Percentage.	Remarks.
Belgian cart-horse	98	68	69·5	Working only on hard pavements.
Danish carriage-horse ..	120	25	21	Do.
Heavy riding-horse	388	36	9	Working on heavy ground and partly on hard pavements.
Do.	132	—	—	Working on light sandy soil.
Light riding-horse	133	8	6	Working on light ground.
Riding-horses (various weights)	140	3	2	Do.
Military horses	200	1	0·5	Working on medium heavy ground.
Officers' horses (heavy) ..	40	3	7·5	Working on varied surfaces.
	1,251	144	14·4	

1. Ossification of the lateral cartilage occurs principally in heavy, coarse-bred horses. 2. The fore feet are more frequently affected than the hind; 3, the cartilage of the left hoof more frequently than that of the right; and 4, the outer cartilage more frequently than the inner. 5. Ossification sometimes occurs at an early age, usually when the animal is first put to work. 6. Well-bred animals are less frequently affected than others. 7. The use of animals of heavy build on hard roads favours the occurrence of side-bone.

The symptoms vary according to whether one or both cartilages are affected, and whether ossification is partial or complete.

Expansion of the hoof is always diminished, and may be entirely suspended. Side-bones produce a clumsy, constrained action, and at times lameness. The symptoms are aggravated by rapid work on hard roads, by allowing the hoofs to become dry, and by using high calkins. When, however, the hoof is kept moist, animals may work for a long time without inconvenience.

The diagnosis of side-bone is easy as soon as the upper margin of the cartilage has become ossified; it then feels hard. On the

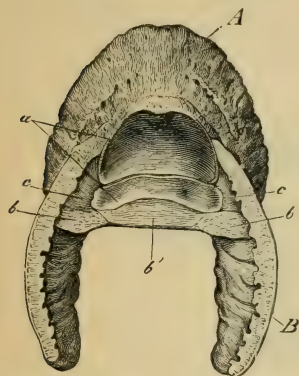


FIG. 513.—A, Pedal bone; B, lateral cartilage cut through horizontally at the level of the pedal-joint; *a*, surface, formed by pedal and navicular bones, for articulation with coronet bone; *b*, postero-lateral ligaments of navicular bone cut through; *b'*, portion of above which are attached to back of navicular bone.

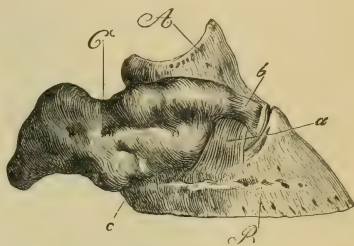


FIG. 514.—Right fore foot. A, Coronet bone; B, pedal bone; C, outer lateral cartilage; *a*, outer lateral ligament of pedal-joint; *b*, ligament connecting lateral cartilage to coronet bone; *c*, band connecting lateral cartilage to pedal bone.

other hand, when ossification has only attacked the lower anterior portion of the cartilage lying within the hoof, it is either very difficult or absolutely impossible to detect the change, though the form of the hoof sometimes gives valuable indications.

The recognised causes are—(1) congenital predisposition, in heavy, coarse-bred horses; (2) excessive concussion produced by work on hard roads, for which reason the disease is frequent in large towns; and occasionally, (3) shoeing with calkins, by which the frog is prevented taking any bearing on the ground and the lateral cartilages are subjected to a continuous inward and downward dragging strain. This is concentrated at the fixed, *i.e.*, anterior,

end of the cartilage, where disease usually commences. Mechanical injury is another undoubted cause. This, and the fact that the outer half of the foot suffers the greater shock during movement, explains why the outer cartilage more frequently becomes ossified than the inner.

The prognosis depends on the horse's work, weight, and breed, on the form of the hoof, and on the extent of ossification. Heavy horses with completely ossified lateral cartilages and contracted hoofs are of little use for rapid work on paved streets; though horses with large side-bones and feet of good shape may work satisfactorily for many years. When only one cartilage is affected, or when the animal is worked on soft ground, side-bones are comparatively

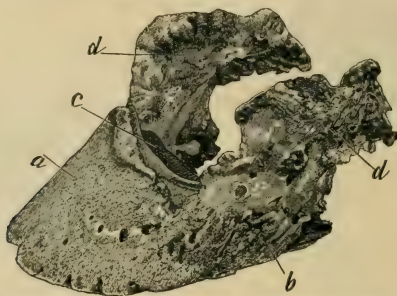


FIG. 515.—Pedal bone, with almost complete ossification of the lateral cartilages. *a*, Pedal bone; *b*, wing of pedal bone, from which point, as a rule, ossification commences; *c*, articular surface; *d*, rough, uneven surfaces of the ossified cartilages.

unimportant. While ossification is in active progress the animal goes tender, if not actually lame, but as soon as it becomes complete the lameness tends to disappear, though it readily returns in consequence of bruising or strain if the tread is not level. Lameness is usually temporary, but the diseased cartilage can never be restored to its primitive condition.

After ossification is complete, lameness may be produced by bruising of the sensitive laminae, which are then enclosed between two hard, unyielding structures—the horny wall and ossified cartilage. The plantar cushion may also suffer from being more or less confined between the ossified cartilages. If, in addition, the wall of the hoof is contracted at the heels, the condition is even more serious. In estimating the effect of the pressure on the sensitive laminae, the fact that only the inferior half of each cartilage is covered by keratogenous membrane should not be overlooked.

Treatment consists in resting the horse, removing the shoes, and placing the animal on tan or other soft bed ; thinning the wall over the affected cartilage, and applying cold poultices. When lameness disappears shoe as directed below. Should lameness persist, neurectomy is indicated, or a mercurial blister may be applied to the coronet and the animal be given two or three months' rest. Firing the ossified cartilage is useless. For sidebones associated with contracted foot, Major-General Smith recommends hoof-section, but the results are not invariably satisfactory. The portion of wall covering the side-bone is isolated by sawing through the hoof from coronet to plantar border in three places, and with a drawing-knife, detaching the segments from their connection with the sole, thus relieving the compression of the sensitive laminae. The fissures in the wall are filled with wax or hard soap, and the foot is shod with a bar-shoe, relieved at the quarters or under the loose segments of horn.

In *shoeing* animals with side-bone it is important to know whether the condition is uni- or bi- lateral. In side-bone of the outer heel the wall of that side is comparatively immobile, and the shoe at the corresponding quarter and heel is excessively worn. On removing the shoe the outer wall is found much higher than the inner. The external heel of the shoe is thin, the internal comparatively little worn. The hoof is either unchanged in form or the wall of the outer heel is contracted, and sometimes covered with rings. The outer portion of the coronet is more prominent, and the outer limb of the frog smaller than the inner. Bruises or strains in the wall not infrequently exist.

The shoe should be flat, the outer limb broader than usual, the seating-out should terminate behind the last nail hole, so that the entire breadth of the heel surface may form a horizontal plane. The outer wall should be lowered more than the inner, and the shoe so formed that its inner limb fits as close as possible, the outer being left sufficiently wide to meet a perpendicular line dropped from the coronet. The supporting surface is thus widened towards the outside, and, in consequence of the level tread, more even wearing of the shoe produced.

When both lateral cartilages are ossified, a thick leather sole materially assists in diminishing shock. Special deeply-fullered shoes with rope inlay are also of value, but pads and bar shoes seem (in theory at least) contra-indicated, and, at first, cause pain by pressing on the frog and so tending to thrust asunder parts that are now unyielding.

Side-bones are often accompanied by corns, which are usually extremely persistent. As, however, these are not primary but secondary conditions, they deserve less attention when choosing and fitting the shoe than the ossification. Under these circumstances "springing" the heels, which is frequently practised in order to relieve corns, produces local strain and pain, and should be avoided.

VIII.—FRACTURE OF THE NAVICULAR BONE.

FRACTURE of the navicular bone is rare, though it has been seen after suddenly throwing a horse on his haunches, and after movements which cause great strain on the flexor perforans, and therefore on the navicular bone. Uhlich found the bone broken in three pieces. When studying at Alfort, Dollar saw three cases of fractured navicular bone in the horses used for surgical exercises. The strength of the navicular bone is lessened, and fracture favoured by chronic inflammation like that accompanying navicular disease; the danger is greater after neurectomy. Fracture of the navicular bone not infrequently results from gathered nail. In cellulitis affecting the sensitive frog, suppuration often extends to the perforans tendon and navicular bone, and if not at once checked, may cause necrosis both of the tendon and bone. Schraml saw fracture of the navicular bone and rupture or tearing away of the perforans tendon from the os pedis, and thinks fracture is caused, after rupture of the tendon, by the excessive pressure of the os coronæ on the navicular bone. It is much more probable that the fracture had caused rupture of the tendon.

Diagnosis principally depends on the peculiar lameness, aided by the history of the case, though in acute inflammation of the navicular bursa the symptoms are very similar to those of fracture. There is less difficulty in diagnosing fracture caused by nail puncture. The foot is continuously rested, and if weight is unavoidably placed on it for a moment, the phalanges show excessive volar flexion. The toe is directed obliquely backwards and downwards. Marked pain is caused by lifting the foot and extending the pastern (dorsal flexion) or by raising the toe. Inflammatory swelling occurs later in the hollow of the heel.

Prognosis is very unfavourable, particularly in compound fractures, caused by picked-up nails. There is always danger of the perforans tendon becoming inflamed, and later, ruptured, or of lameness persisting, hence a useful recovery is extremely improbable.

Treatment is only advisable in valuable animals, like those used for the stud. Complete rest is of first importance in all cases of suspected fracture. At a later period plantar neurectomy may be performed. In complicated fracture caused by picked-up nail, resection of the perforans tendon may be attempted. Humbert, in such a case, claims to have completely resected the navicular bone with success. The foot was irrigated night and day for a month after operation. In two and a half months the animal could trot sound. Möller, who made experiments in this direction, failed to obtain good results, and he seems to entertain considerable doubt of the possibility of cure by resection of the navicular bone.

IX.—NAVICULAR DISEASE.

In England, during the latter half of the eighteenth century, attention was first directed to a disease which had become unusually common in thoroughbred horses. At first it was regarded as a disease of the pedal-joint, or was mistaken for contraction of the foot. It is now impossible to say whether the disease described by Bridges and Gibson as "grain of the coffin-joint" was identical with that now under consideration. Moorcroft states that he had previously seen the disease, though he had not directly recognised it. In a letter dated 1804, Moorcroft warns his correspondent against mistaking simple contraction of the foot for coffin-joint lameness. He describes the first condition, and states that it only occurs secondarily in this disease. Coleman and Turner further observed and described the condition, at first under the title of "coffin-joint lameness," and later of "navicular disease," or "navicular lameness." The French "*maladie naviculaire*" is derived from this.

In Germany the disease was also first termed "coffin-joint lameness." Renner endeavoured more particularly to identify the seat of the disease by distinguishing an anterior and a posterior coffin-joint lameness, and only applied the latter term to the disease now in question. Brauell first described the disease thoroughly and named it "podotrochilitis." Both names—"navicular disease" and "podotrochilitis"—have the merit of at least indicating the seat of the disease.

The navicular bone, by its anterior or articular surface forms part of the pedal or coffin-joint, and posteriorly it presents a gliding surface, covered with fibro-cartilage, over which the perforans tendon passes to its insertion on the semilunar crest of the os pedis. The flexor tendon, below its attachment to the os coronæ, becomes rapidly expanded as it descends, and this portion is often designated the plantar aponeurosis. It is strengthened behind by a fibrous expansion, which blends with the tendon inferiorly and which is attached above to the os suffraginis by two bands. The navicular sheath or bursa lies between the anterior surface of the expanded tendon and the posterior surface of the navicular bone, forming a closed sac which extends downwards to below the interosseous ligament connecting the navicular to the os pedis, and upwards to the middle of the os coronæ, where it is separated from the great sesamoid sheath by an attachment of the perforans tendon.

Acute inflammation of the navicular sheath is most commonly the result of some mechanical injury to the foot, punctured wounds, gathered nails, &c. In the case of gathered nail, the bursa is either directly wounded, or infection extends to it from the sensitive frog. Such acute conditions are described under "Diseases of the Hoof."

In navicular disease the inflammatory process is aseptic, and generally chronic, and the following structures are more or less affected: navicular bone, navicular sheath, and perforans tendon.

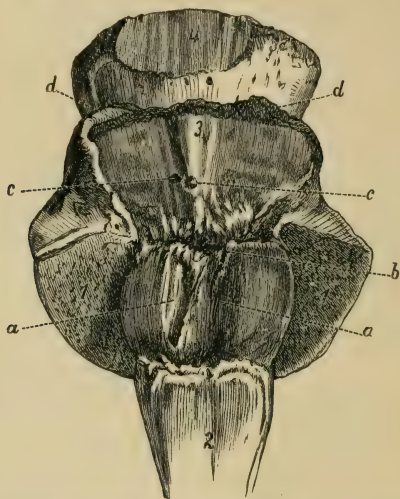


FIG. 516.—Preparation illustrating navicular disease. 1, Os pedis; 2, flexor pedis perforans tendon drawn downwards; 3, lower (gliding) surface of the navicular bone; 4, coronet bone; *a* and *b*, roughened, abraded spots on the flexor perforans tendon; *c*, eroded spots on the navicular bone; *d*, proliferations from the upper margin of the same bone.

Pathology. Opinions are divided as to the point of origin of the disease. Turner places it in the navicular bursa, and Fambach considers the disease starts from rupture of tendon fasciculi. Schrader and others locate the primary disease in the gliding surface of the navicular bone. Brauell, however, maintains that the point of origin is not constant, and that sometimes one, sometimes another tissue first becomes affected. The fact that the perforans tendon is nearly always found diseased does not prove that the first changes occur in it, for immediately the surface of the navicular bone becomes eroded or roughened the tendon is endangered. The gliding surface

of the navicular bone seems to be the commonest point of origin. Both the course and character of the process support this view. Little spots no larger than a millet-seed are to be found here, generally about the centre of the middle elevated portion, over which the fibro-cartilage appears coloured (Figs. 516 and 517). Smith views these as calcareous deposits, but microscopic examination reveals the same conditions as in arthritis deformans, *i.e.*, proliferation of cartilage cells, with fibrillation of the intercellular substance. The cartilage thus altered loses its consistence and becomes eroded (Fig. 517).

As soon as the substance of the bone is attacked, granulations form, causing destruction of neighbouring portions of cartilage and of bone. Rarefying osteitis sets in; the compact tissue, normally of a yellowish-white, assumes a reddish colour, and disappears more



FIG. 517.—Navicular bone in chronic navicular disease (after Brauell).

and more in consequence of increasing proliferation of the medullary tissue. The bone may thus be so much weakened as readily to fracture under pressure of the tendon. Smith states having seen, in certain cases, changes in the compact tissue precede those in the cartilage: this is more frequent where both feet suffer. As a rule, these peculiar osteophytes, which resemble those of arthritis deformans, and appear as though poured out on the surface, can be found on the margins of the navicular bone, and especially on the upper margin, where the bursa extends from the tendon on to the bone. The ligaments of the navicular bone become thickened and sometimes ossified. The upper surface of the bone, which contributes to the formation of the coffin-joint, is never thus affected.

When the condition is preceded by bursitis, which Williams considers common, the parts are more or less reddened and injected, and the bursa is thickened and its surface roughened. Such disease must, of course, affect the tendon and navicular bone.

Finally, inflammation may extend from the flexor perforans to the navicular bone; Fambach, indeed, regards this as the rule. Isolated fasciculi of the tendon are ruptured by excessive strain,

and the process commences. But the course of the disease, and especially its long period of development, contradict this view, though it is a fact that, with few exceptions, the tendon surface is always affected. Smith found disease of the tendon in 99 per cent. of cases. The portion of tendon in contact with the navicular bone at first shows brown-coloured spots, its surface loses its glistening character, and soon shows abrasion. Single fasciculi at the surface of the tendon become ruptured (Fig. 518), partly torn away, and rolled upward. Microscopic examination shows them to have undergone fatty degeneration (Smith). In old cases the tendon may be extensively eroded, and may



FIG. 518.—Flexor pedis perforans tendon in chronic navicular disease (after Brauell).

finally rupture. Almost all such changes in the tendon are, however, secondary. Immediately the surface of the navicular bone becomes rough from loss of the fibro-cartilage, a rubbing action, similar to that between the articular surfaces in arthritis deformans, occurs between the navicular surface and the tendon. The fact that the portion of the tendon most frequently affected is that exactly over the ridge of the navicular bone supports this view, though granulation on the navicular bone may not be the sole cause of change in the tendon :

rupture of fasciculi may perhaps at times be a primary condition, and seems probable where the disease appears suddenly with severe lameness. Under favourable circumstances, and with long rest, union occurs between the perforans tendon and the navicular bone, being favoured by the granulations of the latter. The portions of tendon thus altered may become ossified.

Causes. The predisposition to navicular disease probably depends largely on peculiarities of conformation ; hence the hereditary character of the disease, and its tendency to attack more than one foot at the same time. Smith seeks to explain the disease by referring it to faulty development of the bony tissue of the navicular bone. Theoretically nothing can be adduced against this view, but further investigations can alone determine to what extent such peculiarities act as causes of the disease. One argument against it is, that the

disease almost invariably occurs in well-bred horses, especially in those with narrow, high feet. In coarsely-bred animals it is only seen exceptionally.

Only two cases are reported of the disease also affecting the hind feet. In both cases the investigators (Rainsford and Fambach) confirmed their diagnosis by post-mortem examination, and there is no doubt that chronic inflammation of the gliding surface of the navicular bone and of the perforans tendon had occurred, but no explanation of the cause is given. In Fambach's case the horse was lame for nine months ; as much as possible it avoided placing weight on the limb, and both during movement and at rest kept the limb flexed.

The almost constant occurrence of navicular disease in the flexor apparatus of the fore limb is partly due to the greater weight borne by the front feet and to the violent strains thrown on the perforans tendon during rapid movement on hard ground or under the weight of the rider. Under these circumstances the navicular bone is exposed to severe pressure on the one side from the coronet bone, on the other from the flexor tendon ; and though disease of the bursa is seldom caused by bruises from below when moving over uneven ground, yet such an accident is conceivable. It is still very doubtful how strains, &c., act in producing the disease. The variety of opinion on this point is to some extent due to confusing cause and effect. In no lameness are errors of diagnosis so common as in navicular disease.

The older English authors considered that a small, narrow formation of the hoof often caused this disease, the strongly arched sole pressing on the navicular bone. This view is due to confusing navicular disease with contracted sole, as Brauell has pointed out. Williams regards the upright position of the fetlock as a predisposing factor, a view which is pertinent, so far as the position of the fetlock is in some degree referable to that of the hoof.

Peters and Fambach first explained the connection between this conformation and the disease. Excessive lowering of the heels causes the axis of the hoof to become more oblique than that of the pedal bone, and throws excessive strain on the flexor perforans at every movement. The pressure on the navicular bone thus produced is increased by the flexor tendon describing a sharper curve in its passage over the navicular bone.

Leaving the toe too long may similarly cause the disease, or induce inflammation of the flexor tendon. The upright position of the pastern is not the sole factor, but acts in conjunction with faulty trimming

of the hoof. Williams' view, that the most important factor is the failure to neutralise shock, appears incorrect, because under these circumstances the tendon would escape injury. Finally, it must not be forgotten that uprightness of the pastern may not only be a cause, but also a consequence of the disease.

Peters explains the fact that horses which stand "over" on the front feet more often suffer from this disease, by drawing attention to the sharper angle made by the flexor pedis when passing over the navicular bone, and directs attention to the circumstance that when the limb is loaded and the os pedis in consequence sinks, that tension in the tendon increases, and, consequently, that greater pressure is exercised on the os naviculare.

The frequent occurrence of navicular disease in horses with long pasterns is explained by the greater stress thrown on the tendons. On the other hand, obliquity of the pastern is in some respects an advantage, because the flexor perforans takes a straighter course over the navicular bone.

Excessive pressure on the navicular bone preceding sudden partial rupture of the perforans tendon may give rise to the disease, and was regarded by Fambach as the commonest cause. Möller inclines, however, more to Peters' opinion, viz., that navicular disease is due to slowly-acting influences consequent on change in position between the bones of the limb or between them and the hoof axis, an idea which receives support from the slow character of the change. In riding and carriage horses, initial injury may be occasioned by sudden reining-in, jumping, continued sharp trotting, galloping, and occasionally even by slipping.

English authors, among them Turner and Goodwin, think it may be caused by long rest, desiccation destroying the elasticity of the hoof and favouring the disease. Möller does not agree with Smith in thinking that continued standing on a particular foot causes the disease. He has often seen laminitis and descent of the os pedis under such conditions, but never navicular disease. Some of the above views may be due to faulty diagnosis and mistaking other conditions for navicular disease, especially considering the favourable course noted by the older English authors, who report 90 per cent. of recoveries. Many practitioners consider that concussion and constant hard work on paved streets are the chief causes of navicular disease.

In rare cases the disease may be preceded by influenza, pneumonia, or rheumatism, and it has been supposed, without much justification, that during the currency of the primary disease the navicular sheath may become infected.

Symptoms and course. (1) Lameness. On account of its slow development the beginning of the disease is generally overlooked, and attention only directed to the parts after pain and lameness are present. Many cases are ushered in by slight unaccountable lameness or by loss of action, which is often best marked in trotting downhill. Lameness begins gradually: the first few steps, particularly if taken on hard ground, are painful, but this often disappears completely with exercise. When both feet are affected diagnosis is still more difficult. There may only be a tendency to stumble (Smith). The seat of disease explains why pain should be most marked when weight is placed on the limb. Even in the stable the diseased foot is rested—the horse pointing. As pressure on the affected navicular bone is greatest when the limb is directed backwards, at which time, of course, the flexor perforans is in greatest tension, the animal endeavours, as far as possible, to shorten this phase of movement, and, to remove weight from the tendon, the foot is held in a position of volar flexion with the pastern bones upright, sometimes to such a degree that the heels scarcely touch the ground. The gait then becomes stiff and insecure, and the animals readily stumble. When both feet are diseased the animal tries to shorten those phases of movement in which weight is borne exclusively by one foot, and the limb is therefore carried stiffly and rapidly forwards. Spooner says the animal moves as though it had a wooden leg. Owing to the pain the horse moves slowly, sweats, and soon becomes exhausted.

Sometimes the difficulty in movement disappears after a few steps: sometimes it is permanent, or may even increase with exercise, depending on the position, nature, and extent of the disease. It is usually more marked after a short rest following great exertion. It occasionally disappears completely after a long rest—a fact which renders diagnosis difficult, and may give the impression of recovery. To sum up, lameness when weight is placed on the limb, increased after considerable exertion, decreased by long rest; volar flexion of the phalanges and extension of the foot, particularly during the first few steps.

(2) Changes in the hoof. The local inflammation may be detected by exercising pressure on the navicular bone. One jaw of the pincers is applied over the centre of the frog, the other over the wall of the toe. Hertwig's special pincers are unnecessary; but if the sole and bars are very thick, they should be thoroughly pared before using the pincers. Pain can sometimes be detected by pressing with the thumb in the hollow of the heel. In doubtful cases Brauell

recommends exercising the horse after applying a bar-shoe, the bar of which covers the centre of the frog. This increases the lameness in real cases of navicular disease.

In some cases forcible dorsal flexion gives pain. The foot is lifted as in shoeing, and the toe pressed slowly and powerfully downwards, or the horse is so placed that its toe rests on an elevation, thus causing the heels to be abnormally low when weight is placed on the foot. The same thing often occurs accidentally when the horse is moved on uneven ground, and produces very marked lameness.

As a rule, there is no great increase in the warmth of the foot, but in advanced cases the foot varies much in temperature. During the further course of the disease the hoof contracts, and the heels become longer and narrower. As the patient no longer places weight on the foot, local nutrition and horn production suffer, and the coronary band appears more prominent, and seems swollen. The uprightness of the pastern causes the hoof to take a more perpendicular position as time goes on. The frog is also relieved of pressure, and this, with defective expansion of the hoof, leads to shrinking of the heels and atrophy of the frog—in short, to contraction of the foot, the sole then appearing abnormally concave. Although contraction of the hoof is important in diagnosis, it should never alone be relied on, because, as Haubner pointed out, the left foot is often smaller than the right.

The quality of the horn also suffers during the disease. The wall frequently appears uneven, rough, or covered with rings, and its horn brittle.

In the later stages the muscles of the shoulder become more or less atrophied, depending on the degree of lameness (atrophy of inaction).

In the diagnosis of navicular disease attention should be directed to the discovery of its typical symptoms: pointing the foot, which may be only advanced a few inches, wearing the toe of the shoe, upright pastern, alteration in the shape of the foot (narrow heels, atrophied frog, increased concavity of the sole), and lameness with short, "pottering" action on the horse first coming out of the stable, or after a short rest, followed by marked improvement of action under exercise. In many cases pointing may be absent or overlooked, and the foot or feet may be normal in shape. By injecting a few minims of a 5 per cent. solution of cocaine over the course of the plantar nerves, temporary anæsthesia of the lower portions of the limb is produced; disappearance of lameness under these circumstances suggests that the seat of disease is in the foot.

The lameness may disappear with long rest, but always returns after hard work. Weeks and months pass, until at last it becomes necessary either to get rid of the animal or to perform neurectomy. Recovery is rare, and supposed cures mostly result from faulty diagnosis or from mistaking remission for recovery, as shown by the opinions of the older English authors, who put the average of recoveries at 90 per cent. Bracy Clark, an able observer, assesses them, on the other hand, at 1 in 16. From the nature of the disease, recovery must be rare, and can only occur during the first stages, *i.e.*, while the disease is confined to the bursa of the flexor tendon. Prognosis is most favourable when, on account of the sudden onset of lameness, there is a probability that inflammation is confined to the tendon and bursa, and that the tendinous surface of the navicular bone is still intact. But when atrophy of muscle or hoof has set in, improvement is not to be expected. Exceptional cases are seen, however, where recovery, or at least cessation of lameness, is produced by adhesion of the perforans tendon to the navicular bone. Gerke confirmed this by a post-mortem two years after the disappearance of lameness. Peters had a similar case, but such a termination is very exceptional.

Neurectomy, often resorted to to remove sensation, is apt to be followed by rupture of the perforans tendon. The tendon becomes more and more abraded by the rough surface of the navicular bone, until at last, at a moment of excessive strain, it suddenly tears through, leaving the horse completely useless. Temporary improvement following long rest must not be mistaken for cure.

The disease is very common, and is often confused with diseases of the hoof and other lamenesses. Errors are easy, unless plenty of time is given to the examination, and diagnosis sometimes proves difficult, even to the most practised.

Navicular disease may be mistaken for sprain or wrenching of the ligaments of the coronet-joint. This lameness is usually more severe. The posterior surface of the coronet-joint is then the seat of pain, whilst pressure on the sole causes no flinching. The symptoms of sesamoid lameness present a certain similarity to those of navicular disease (see "Sesamoid Lameness"); a careful local examination is therefore necessary.

Treatment. As above stated, recovery is only possible when the local changes are capable of repair. Disease which starts as an acute bursitis or tenositis offers some chance of cure, though inflammation soon extends to the fibro-cartilage of the navicular bone, and the condition becomes as intractable as if it started at this point. In

recent cases, long rest and refrigerant treatment sometimes check inflammation and assist repair. The horse may be turned out to graze in a meadow with a clay bottom, where the soil is always moist. If kept in a box soft bedding, like sawdust, tan-bark, or peat, should be provided, and the feet kept moist; thoroughly paring the hoof, so as to assist the action of cold moist applications, is useful.



FIG. 519.—Straight seton needle.



FIG. 520.—Curved seton needle.

Shortening the toe and shoeing with "tips" is also of value. The presumed efficacy of bleeding (recommended by Turner and Goodwin) and of frog-setons (Sewell) depends on errors in diagnosis. In recent cases, the rest rendered necessary by setoning assists repair, but Brauell rightly questions the curative action of setons. Continued rest is known to alleviate the lameness, and is sometimes resorted to by horse-dealers preparatory to sale. Frog-setons were first recommended by Sewell, who constructed a special sharply-curved needle with a handle and sharp point (Fig. 520) for the purpose of

inserting them. The point of the frog is first pared away, and a twitch having been applied to the nose or ear, the needle, previously threaded, is thrust into the hollow of the heel, through the plantar cushion, so as to emerge near the point of the frog. The handle is then removed, the needle drawn through the frog, and the ends of the tape knotted together at the heel. The seton is left in position twelve to fourteen days, being moved daily to allow free discharge of pus. Sometimes it is saturated with oil of turpentine.

Recently at the Army Veterinary School, Aldershot, radium has been tried by Major Newsome, in the treatment of a few cases of navicular disease, and the results must be regarded as very encouraging. The radium salt was placed in the frog over the navicular region, and retained in position by a bandage. The affected feet were exposed to radium emanations for periods of 90 to 168 hours, at intervals of five to seven days, and in every case immediate relief followed the applications, though in some lameness recurred when the animals resumed work.

If other treatment fails, nothing remains but to perform neurectomy—either plantar, or median with external plantar (see section on “Ringbone”). Tenotomy proposed by Brauell and recommended by Smith to assist adhesion of the perforans to the navicular bone, has not proved successful. Möller doubts the utility of resection of the flexor tendon, as in his hands it has usually left the horse either permanently lame or has necessitated so long a rest as to be of no practical service.

A valuable carriage-horse, which had for a long time suffered from navicular disease, contracted acute inflammation of the navicular bursa in consequence of bruised sole. Operation was at once resorted to, and the navicular bone and perforans tendon found to be chronically diseased. The case did well, and the horse returned to work, but for several months trotted slightly lame.

Proper shoeing is of great importance, both in preventing and treating this disease. In general, it is well to shorten the toes and lengthen the heels, either by suitably paring the foot or by applying leathers or shoes with thick heels.

In marked contraction of the foot, indiarubber or cork pads or long-heeled shoes may be employed. Defay's shoes sometimes diminish lameness considerably; their action is assisted by moderate exercise on soft ground and by foot-baths (see Dollar and Wheatley's “Handbook of Horse-shoeing”).

X.—DERMATITIS IN THE FETLOCK REGION. MUD-FEVER— CRACKED HEELS—GREASE.

THE names “mud fever,” “cracked heels,” and “grease,” have been used since olden times to designate diseases of the skin about the fetlock and particularly on its posterior surface. They vary considerably in their nature and course, though certain characters are common to all, viz., their point of origin in the heel, their inflammatory nature, and spontaneous appearance.

(a) **Dermatitis erythematosa.** This is the mildest form of dermatitis, and is commonest in horses with thin fine skin; well-bred animals suffer more frequently than heavy working-horses. In many horses the skin of the pastern-joint seems exceedingly sensitive, so that even the presence of sand in soft soils may cause irritation, and give rise to this form of dermatitis. Similar results have been noted after long-continued exposure to direct sunlight. The unpigmented skin appears red and rather painful, but after a few days these symptoms disappear, and active desquamation sets in. The disease consists of hyperæmia of the papillary layer of the skin, produces no permanent injury, and only occasionally requires special treatment. When, however, the condition is neglected, and the horse continues to work, this form of dermatitis may give rise to the next in order.

(b) **Dermatitis eczematosa.** Mud-fever, cracked heels. Eczema, or inflammation of the skin, appears spontaneously, is ushered in with swelling and redness, is usually soon followed by exudation from the surface, and in general takes a typical course, which, however, is less easily studied in this position than in others. The swelling and redness are often scarcely visible, though there is lameness, especially when the animals are first moved, whilst the surface of the skin becomes covered with a yellowish-red fluid, which soon dries to a brownish crust. The papular stage is not well marked, though the vesicular stage, *i.e.*, the formation of small bladders, may sometimes be noted. The weeping stage (*stadium madidans*) appears more distinctly, and is rapidly succeeded by the formation of crusts (*stadium crustosum*). The crusts soon loosen under proper treatment, and desquamation follows (*squamous stage*), revealing normal epidermis. In characteristic cases the process takes eight to fourteen days, and ends in complete recovery, but not infrequently complications occur, especially if the animals are worked during the disease. The movement of the inflamed skin produced by walking, assisted by the presence of exudate, interferes

with regular healing and leads to the formation of cracks, fissures, and folds. Chronic proliferation then sets in around these, producing in the hollow of the pastern ridge-like cicatrices, which can only be removed by operation.

During the acute stage the animals go very lame, especially for the first few steps, but improve after a short time at exercise.

Causes. Coarse-legged horses with long hair often suffer from this form of dermatitis when working on wet ground. The epidermis is continually moistened, becomes macerated, and inflammation is then readily produced in presence of infective substances. The absence of visible external cause, and the simultaneous appearance of disease in several limbs, or in several animals in the same stable, gave rise to the idea that mud-fever was a blood disorder, and should be regarded as a metastasis or as erysipelas. Observations made on men, dogs, and other animals, seem, however, to favour the belief that eczematous disease may be associated with constitutional changes, which are at present very imperfectly understood. Joly and Truche regard it as contagious, although the specific organism is unknown. Truche seems to rely on the fact that the disease attacked several horses in a previously healthy stable after the introduction of some American horses suffering from it. The fact that the same causes were acting on a considerable number of animals at the same time was overlooked.

Eczematous dermatitis is usually produced by external irritation either of a mechanical, chemical, or specific character. The disease often occurs soon after shoeing with high heels, because the changed position of the foot favours the formation of folds in the skin just above the heels, in which sand and dirt lodge and produce excoriation. One of the commonest causes of mud-fever and of cracked heels in town horses is to be found in the habit of washing horses' heels with strong alkaline soaps (like soft soap) and hot water. The soap irritates, and the hot water produces vascular relaxation and congestion, which are liable to be followed by inflammation. Somewhat similar results are produced, in heavy horses, by washing the legs with a cold-water hose after returning from the day's work. Omnibus and cab horses, whose legs are only roughly rubbed dry and are cleaned next morning with a brush, seldom suffer from any of these forms of dermatitis. An excellent method of drying and cleansing the legs simultaneously, is to rub them freely with clean pine sawdust. Animals working on stubble or freshly-laid roads or forest paths are apt to contract slight skin injuries, which sometimes form the point of origin of disease; the wound discharges, macerate the epithelium, irritate the skin, and produce inflammation.

Grünwald describes an enzootic dermatitis which appeared during the hottest part of summer amongst horses stalled in open sheds, and in which the lower portions of the limbs were continually exposed to the sun's rays. Horses sheltered from the sun were not affected, a fact which led Grünwald to compare the condition with erythema solare of man.

Kropfl noticed the same thing in horses at grass. Only the unpigmented portions of skin in the hind limbs seemed to be diseased.

Bermbach believed that mud-fever was conveyed from horse to horse by using the same washing-pails, &c. More probably the same general external influences were at work.

Amongst chemical irritants must be numbered chalk-dust. In the army its action is often troublesome, on account of horses becoming affected immediately they are brought into chalky regions. The action is chemical, as shown by the fact that disease is favoured by washing the legs, the best preventive being simply to cleanse the parts with a dry cloth.

Course. Early and appropriate treatment generally results in complete cure in eight to fourteen days. When, however, the disease is neglected, recovery is impeded by the formation of fissures and of new connective tissue, which latter sometimes produces prominent thick swellings in the pastern. Though simple cracks soon heal with rest and proper treatment, large masses of new tissue are very often difficult to deal with. Before giving an opinion, the parts should therefore be thoroughly examined.

The treatment of eczematous dermatitis requires in the first place rest, because movement keeps up inflammation and favours the formation of fissures and of excessive quantities of cicatricial tissue. The skin should be carefully cleansed with warm water and a neutral soap, the swellings rinsed with an antiseptic solution, dried, and dressed with iodoform and tannin (1—3). After the preliminary washing and disinfection, it is very important to avoid again wetting the parts. This is one of the chief secrets in the successful treatment of these forms of dermatitis. Astringent dusting powders are generally useful. Pyoktanin has been highly recommended, but its powerful staining properties render it unpopular. Thioform, dermatol, glutol, and amyloform (all compounds of formic acid with neutral bases) are easy to use and efficacious. An ointment of red oxide of mercury one part, with paraffin base or lanolin ten parts, is useful. It may be smeared on wadding, laid on the surface of the wound, and fixed in position by a bandage. This dressing may be left in position until wet through, when the diseased

spot is again cleansed and the dressing renewed. Daily immersion of the affected heels in a warm astringent bath, followed by dry dressing and bandaging, often hastens recovery.

To check excessive proliferation ("proud flesh") and to promote cicatrisation, astringents like alum or sulphate of zinc may first be tried; and in the event of their proving unsuccessful, the actual cautery, nitrate of silver, or sulphate of copper, is often of service. Cicatrices which project above the skin, or which, from contraction, have become hard and sharply marginated, can only be dealt with by the knife, caustics being in most cases useless. The portions of growth overtopping the neighbouring skin are removed, with anti-septic precautions. The parts should be washed with sublimate, creolin, or carbolic solution, and a dressing moistened with one of these materials applied and left in position twenty-four to forty-eight hours. This disinfects the point of operation. In quiet animals, the parts may be removed whilst standing; if necessary, cocaine can be locally injected. Restive horses should be cast. The foot is extended as far as possible—in the case of the hind foot, it may be bound to a front one. The incisions should be smooth and regular; bleeding is generally slight, and can be checked by a pressure dressing, which at the same time prevents excessive new growth. By resting the animal and keeping the stall dry, healing is generally complete in eight to fourteen days, provided the growth is not extensive, *i.e.*, not more than 1 to 2 inches in size, otherwise cicatrisation proves difficult, and the growth may recur. Möller repeatedly removed growths of this kind from the hind pastern, and cured cases in which medical treatment had proved useless.

(c) **Dermatitis gangrenosa** consists in limited spontaneous necrosis of the skin of the pastern or coronet, occurs particularly during winter, and is oftenest seen in large towns. It has been termed "frost bite," and "coronary sloughing."

Causes. The fact that gangrenous dermatitis occurs almost always in winter, and especially in cold countries, has suggested the idea that it is due to freezing of the skin. That the disease does not occur so much during periods of excessive cold as during thaws was not held to altogether disprove that view; for it seems natural that moist cold should be particularly injurious, by neutralising the protection afforded by the hair, and enabling the cold to act directly on the skin. The theory, however, is not in keeping with the local character of the disease. Were cold the sole agent, symptoms of freezing in the first and second degree might fairly be looked for around the necrosing spot. They are, however, generally absent.

The experiments of Siedamgrotzky and Jelkmann showed that the lowering of temperature, consequent on the use of salt (which is particularly common in large towns), could not be held responsible for the production of the disease. And, finally, it should be noted that at times, when gangrenous dermatitis is common, all wounds show a tendency to necrosis. It, therefore, seems tolerably clear that local freezing is not the only cause, but that other factors, partly of an infectious, partly of a chemical character, are also at work. Slight injuries to the lower portions of the limb lead to infection, which may result in inflammation and necrosis. Low temperatures depress the vitality of existing wound surfaces and thus favour septic invasion. Whatever view may finally prove correct, thus much is certain, that as a rule infection acts along with cold in giving the first impulse to the production of gangrenous dermatitis. The cases seen about the coronet and front of the pastern are often initiated by "treads"; the horse injuring the skin with the calkin of the opposite shoe, and the wound becoming infected. That this form of dermatitis does occur, in exceptional instances, even in the warm season, only shows that necrosis of the skin may be produced independently of cold.

Symptoms and course. The disease appears suddenly, generally overnight. There is lameness in one or other limb, with inflammatory swelling of its lower portions, sometimes also of the upper parts. Fever is also common. Closer examination detects at a given spot a portion of skin, from 1 to 2 inches in diameter, which is soft, yielding and swollen: pressure over this spot causes severe pain, and produces discharge of a reddish turbid fluid. The pastern is the most common seat of disease, at a point just over the bulb of the heel, or on the anterior surface of the coronet. The pain continues, the limb increases in size, and in two to three days the necrotic portion of the skin is cast off as a soft, grey, slimy mass: the resulting wound then becomes covered with granulations, which gradually fill up the cavity. In favourable cases a cicatrix forms, and recovery is complete in one to two weeks.

But the disease does not always take so favourable a course; sometimes the infective inflammation extends downwards to the lateral cartilage, or the coronet bone, or penetrates to the sheath of the flexor tendon. In the first case a quittor forms, in the second an exostosis, which later becomes a ring-bone. And if in such cases suitable treatment often leads to recovery, *i.e.*, to removal of lameness, yet when the coronary vessels, or the sheath of the tendon is also attacked, death may occur in a short time from septicæmia.

In the neighbourhood of the coronet, the process may extend to the coronary band, and produce severe inflammation, followed by separation of the hoof.

Prognosis depends on the extent, position, and character of the disease. The larger the necrotic piece of skin, the greater the difficulty of treatment, and the danger to deeper-lying structures. Necrosis near the coronet threatens the pedal-point, in the pastern the sheath of the flexor tendons. Implication of tendon sheaths at once renders prognosis unfavourable. The same is true of a complication like septicæmia ; in this case the swelling rapidly extends upwards, often to the elbow or stifle, becomes very painful, and is accompanied by high fever. The continuance of great pain after the necrotic portion of skin has separated is an ominous symptom.

Treatment. As a preventive measure, the pasterns in winter, and especially during thaws, should be kept as dry as possible, and care taken to protect them from the street mud, which macerates the epithelium, and favours infection and necrosis. The hair on the fetlock, and especially on the back of the pastern, may be anointed with a neutral fat like vaseline or lanolin, so as to keep off mud and water. This precaution can be strongly recommended. For a similar reason, the feet should be carefully cleansed after work, and if possible dried. As urine and stable manure also have a very injurious action, cleanliness in the stable should be insisted on, and after the floor has been swept a dry disinfectant powder should be used. Holes in the floors, in which urine accumulates, must be filled up. If horses with injuries like cracks or fissures of the heels are kept at work, the wounds should be carefully cleansed and smeared with tar or creolin ; and if the external temperature be below the freezing-point, a dressing may be applied.

If necrosis has already set in, its further progress may be prevented or checked by placing the parts in a lukewarm bath of sublimate, iodine, or carbolic solution, with which the affected spot may be frequently washed. At night a bandage should be used, moistened with camphor, or 10 per cent. chloride of zinc solution. Möller had excellent results from applying 1 to 3 per cent. solution of pyoktanin to the diseased spot by means of a mass of tow, fixed in position by a bandage.

It is of importance to hasten separation of the necrotic piece of skin ; and if the entire piece cannot immediately be removed, loose portions at least should be cut off with scissors. The granulations are generally very abundant, and, being irritated by movements of the limb, are apt to become excessive and irregular. In such cases

amyloform, glutol, or tannoform may be freely applied, the parts enveloped in a thick layer of cotton-wool, and bandaged with considerable pressure. At least once a day the dressing should be renewed, all hard fragments formed by drying of the powder and discharge being gently removed. When the wound becomes dry a little lanolin or other neutral lubricant should be substituted for the powder, the cotton-wool pressure dressing being continued. As a rule, it is more necessary to restrain than to excite the formation of granulations. If the patient be moved too soon they become excessive, and fungous growths appear, which give much trouble. If the coronet become swollen, the horn below must be thinned.

A common sequel of coronary sloughing is the formation of sinuses just above the heels, in consequence of a necrotic piece of tissue being retained in the depths, and keeping up chronic inflammation and pus formation. The passage of a sublimate seton, or the injection of liquor Villati, is sometimes sufficient to procure healing, but in obstinate cases it may be necessary freely to lay open the parts.

(d) **Dermatitis chronica verrucosa.** Verrucose Dermatitis, or "Grease."

This disease is always chronic and progressive. Originating in a small spot at the fetlock, the process gradually extends until it may involve the leg up to the knee or hock. In other cases a considerable area may be attacked at the outset. It is due to active proliferation in the rete mucosum; the cells produced, however, do not become horny, but break down and form a fatty, ill-smelling, grey mass on the surface of the diseased skin. In less rapidly progressive forms the cells form a grey, mealy mass. The more intense the process, the more active the proliferation, and the more abundant the exudation which bathes the surface of the skin. The papillæ at the same time increase in size, so that they appear like large warts, and are easily seen. The deeper layers of the cutis, and even of the subcutis, take part in the chronic disease, producing marked elephantiasis. The process extends to the hair follicles; the hairs are mostly shed, and the few which remain stand erect.

Jenner declared equine grease to be identical with cow-pox. Since his time "protective grease" has even been spoken of, though neither Jenner's experiments nor those instituted later in any way support this view. Many years ago it was denied by Leblanc, Delprato, and by other observers, and at the present time no doubt exists that grease is dissimilar to variola. Dieckerhoff has suggested that Bouley's "protective grease" was probably stomatitis pustulosa contagiosa (horse-pox). Horse-pox is attended with fever, is very contagious, may effect any portion of the

skin, though it is often confined to certain regions or even to one, and runs a comparatively simple, benign course, leading to recovery. When affecting the mucous membrane of the mouth and lips it constitutes the above-mentioned stomatitis pustulosa contagiosa.

Leblanc in 1850 made microscopical examinations of the diseased skin, and regarded the condition as a simple hypertrophy. He found the hair follicles, and sebaceous glands enlarged. In another section it has been pointed out how closely this process resembles canker. Either disease may extend to new structures, giving rise to the other; thus grease may produce canker, and canker grease.

The disease is more frequent in the hind limbs, particularly in hairy-legged horses; sometimes it seizes on several legs, one after another. Whether a specific organism is the causative agent remains for the present undecided, though such an explanation appears probable. Sometimes the disease originates from the eczematous form of dermatitis; not infrequently it is due to slight grazes or scratches.

Möller saw many outbreaks of this form of grease in certain stables; indeed, there seems to be some ground for referring them to direct infection. In large establishments animals in hospital were often attacked after being rested for some time, and in one case the horse-keeper suffered from an eczematous disease on the hands. Every practitioner has noticed how the disease is transferred from the affected leg to the sound one by rubbing. The local appearances and gradual spread of the disease point to infection, though its immediate cause is yet unknown. The variations in its method of outbreak and course suggest that it may be due to more than one cause.

Prognosis. Spontaneous recovery is very rare. As with canker, careful and often prolonged treatment is required. The greater the extent of the disease, the more active the proliferation and consequent thickening, and the further the growth has penetrated the papillary layer of the skin the greater the difficulty in treatment. The dry form is most hopeful. When the papillæ have attained a considerable size, and folds exist in the skin, much less can be done,

Treatment. The condition being unquestionably a local skin affection, internal treatment is of little value, and the chief indications are to cleanse, and keep clean, the diseased skin, rapidly to remove decomposing secretions, or to prevent decomposition occurring. When the process is confined to one small spot, the parts may be cleansed, a white-hot firing-iron passed several times over the diseased surface and a disinfectant applied. In more extensive attacks the

limb may be bathed several days in succession with lukewarm chloride of lime solution, or with carbolic or sublimate lotion, and the diseased spots repeatedly washed during the time the limb is in the bath.

A surgical dressing is afterwards applied, containing a mixture of creosote and spirit (1—6), chloride of zinc (1—10), or creolin (5 per cent.).

Lies, of Brunswick, claims to have had excellent results from the use of sulphuric acid. The parts are carefully cleansed, the diseased surface painted with a mixture of sulphuric acid and spirit (1—10, or 1—20), and a dressing, moistened with the same fluid, applied. A little exercise should be given every day ; rest favours the disease.

Dollar commences treatment with a dose of physic, and restricts the diet to bran, linseed, chaff, and green foods. After applying a very large warm bran poultice containing 2 to 3 per cent. of creolin for twelve hours he recommends washing the parts thoroughly with 2½ per cent. creolin solution, and carefully drying. The application of water is afterwards carefully avoided, unless thick crusts form. Cleansing is effected with a large handful of clean cotton-waste vigorously applied, and the parts are thoroughly saturated twice a day with a lotion of zinc sulph. and alum varying in strength from 5 per cent. up to saturation point. Severe cases with the formation of "grapes" are vigorously cauterised with a hot iron, and the above lotion applied twice daily. Dilute sulphuric acid is only employed in very old standing cases. With this treatment Dollar has had most excellent results. Success depends on regular and vigorous treatment.

Large "grapes" are removed with scissors, knife, or, better, with the hot iron. The whole surface may then be freely powdered with an astringent substance like iodoform-tannin, dermatol, glutol, amyloform, thioform, or a mixture of zinc sulphate, alum and boric acid, and covered with a surgical dressing. The dressing must be applied with moderate pressure, and renewed daily. Ointments are to be avoided until the surface becomes dry, when it may be beneficial to apply a little red oxide of mercury and paraffin or lanolin ointment.

Treatment should be continued until the last trace of discharge has disappeared ; the lower parts of the limb must then be kept as dry as possible, and any relapse treated in the above manner.

Dalrymple recommends a hot poultice of wheat-flour and linseed-meal, to which acetic acid is added as the poultice becomes firm. This is applied for twenty-four hours, the surface of the skin cleansed with a dry cloth,

and afterwards rinsed with chloride of zinc solution. He states having thus cured cases in fourteen days.

Straube lately recommended camphor dissolved in ether, and mixed with three times its weight of vaseline; this ointment is rubbed into the diseased skin. To check evaporation, the diseased parts are covered with carbolie wadding, and surrounded with flannel bandages. At first the dressing is changed daily, later every two or three days. When there was much itching, Straube gave arsenic internally with success. Möller seems to prefer sulphuric acid and formalin to all other materials. Their application is certainly painful, but the results are generally good.

DISEASES OF THE HIND LIMB.

A. DISEASES OF THE QUARTER.

I.—INJURIES TO THE MUSCLES AND FASCIÆ OF THE QUARTER.

(a) STRAINS and ruptures of the muscles of the quarter result from slipping, rearing, casting, or falling in jumping, and occasionally from over-exertion in moving heavy loads. Lameness usually follows, and may even prove incurable.

In a case of extensive tearing of the biceps femoris muscle at its origin on the ischium and gluteal fascia there was no lameness, but the animal's appearance suffered in consequence of the large depression that appeared at the site of injury. Another horse ruptured the semi-tendinosus muscle, producing a deep groove. The hind limb was afterwards carried and placed much in advance of its normal position. Lameness disappeared in two months.

A horse which ruptured the gracilis muscle by jumping, showed lameness when the leg was off the ground (swinging leg lameness); the hip-joint appeared to sink and rise abnormally, and the stifle and hock joints were but partially flexed each time the leg was advanced. Lameness disappeared in a few days, but the inside of the thigh revealed a permanent depression over the muscle.

During a race a horse completely ruptured the semi-membranosus and adductor magnus, and to a partial extent the pectineus and adductor longus; severe lameness and marked swelling followed, and, treatment proving unsuccessful, the animal was killed. An army horse caught one of its hind feet in the ground whilst in the act of jumping and ruptured the superficial gluteus 3 or 4 inches in front of the hip-joint. No weight could be placed on the limb, and all the joints were flexed. Six weeks later the horse was able to walk, but remained lame for a long time afterwards.

As a rule strains can only be recognised by the lameness they evoke; the limb is dragged, the movement uncertain, the limb being thrown too far backwards or forwards, or to one side. Palpation sometimes reveals local pain.

Muscular ruptures produce lamenesses of very varying severity and symptoms, depending on the region involved. Sometimes the lameness persists indefinitely, sometimes it rapidly disappears. The longer it persists the more remote becomes the hope of recovery.

Treatment consists in the first stages in rest ; if pain be present, hot fomentations often give relief ; at a later stage massage and exercise are indicated, and if recovery is delayed, counter-irritation may be tried.

(b) Bruises and wounds are commonest in horses, especially in winter, and are caused by kicks, or falls in the street. They also result from thrusts with the carriage-pole, from collisions, or from animals slipping in front of the carriage and being dragged or run over. In army horses wounds and bruises result from falls, kicks, lance thrusts, sabre cuts, or falling on the rider's spur.

Blows may rupture large blood-vessels and produce extensive hæmatomata. Sometimes the skin and muscular tissue are torn through. The biceps femoris is often the seat of such injury, and in collisions the semi-tendinosus and semi-membranosus muscles are liable to be extensively injured. In heavy horses, wounds from stable-forks are often followed by septic cellulitis, which extends and produces destruction of the intermuscular connective tissue of the buttock, sometimes even necrosis of the tuber ischii. After the cellulitis has subsided, sinuses may remain and give great trouble.

Prognosis and treatment follow general principles, but one fact should always be borne in mind, viz., that the extravasation which follows bruising, and sometimes violent over-extension of muscle is seldom troublesome, if not too early incised.

In fresh cases, continuous cold irrigations and complete rest are most useful. By putting the patients to work or moving them too early, fresh bleeding and increase of the hæmatoma are favoured. To assist resorption, small extravasations may, after the third or fourth day, be treated by massage ; for larger ones, such treatment is seldom beneficial, or takes longer than healing after puncture with evacuation of the contents. Nevertheless, the knife should not be used before the fifth or sixth day after the appearance of swelling, partly because of the danger of after-bleeding, partly of infection and cellulitis. In five to six days thrombus formation is so far completed that bleeding is no longer probable, and the walls of the hæmatoma are sufficiently infiltrated with plastic material as to check the penetration of decomposition products. For the same reason, the opening should be made at the lowest point, the cavity emptied of coagulated blood as far as possible, and washed out with a disinfectant. A drainage-tube may be necessary. By adopting these precautions rapid healing is secured. Needless to say, careful disinfection is of the greatest importance.

(c) Wounds confined to the skin of the buttock often heal by

primary intention if immediately sutured with antiseptic precautions, and dressed with a disinfectant like iodoform-tannin. Union is assisted by protecting the wound with a clean cloth, which is kept moistened with a disinfectant. Rest is absolutely necessary.

Muscular wounds in this position heal most rapidly under a scab. If, as is not infrequently the case, the entire wound-surface is open to the air, this will be found the best procedure. The wound is carefully cleansed, rinsed with a disinfectant, any loose fragment of tissue is removed, and after bleeding vessels have been ligatured, the parts are powdered with iodoform-tannin. As a rule, this produces a dry scab, which is firmly adherent to the wound; nothing further is required. If the scab separates at certain points, it should be removed, the discharge wiped away with a little wadding, and the dressing renewed. Sometimes only the upper part of the wound heals under the scab; but though the lower portion is wet with discharge, granulation and healing are only delayed, not prevented. When the surfaces of the wound are in contact, or when pockets or deep injuries exist, it is difficult to maintain asepsis, and suppuration almost always occurs; in such cases, drainage must be assisted and extension of suppuration checked by a free use of the knife, by making counter-openings, and possibly by inserting gauze drains, the wound being meanwhile frequently cleansed,

Even when healing by first intention seems out of the question, recovery may be shortened by inserting stitches, particularly if the skin be separated from subjacent structures to any great extent. By bringing the flaps of skin together with thick threads, or, better still, with tape, which is not likely to cut, retraction of the cicatricial tissue in the edges of the wound is checked, and in large wounds healing is assisted.

Sinuses extending to the tuber ischii must be laid open, and the necrotic piece of bone removed.

II.—FRACTURE OF THE FEMUR.

IN spite of its protected position, the femur is not infrequently fractured in the different species of animals—in dogs, by treads, in horses and oxen by kicks and falls. Horses fracture the bone by struggling violently when cast, especially if the foot be fixed too high (that is, if the hoof be drawn up over the elbow-joint), and over-extended whilst in this position. Gurlt thinks that tying the hind limb to the cannon bone of the fore limb may cause fracture of the femur; but though German operators often fix horses in this way,

no fractures seem to have been reported in consequence. On the other hand, Möller considers that tying the limb to the fore-arm or fastening it to the ring of a surcingle is dangerous. Fracture is favoured by absolutely fixing the hind limb in a position of flexion, on account of the great strength of the extensor muscles of the quarter. The less the resistance to their contraction, the less likely is fracture of the femur to occur. Lichte described fracture of the femur in a horse affected with lateral luxation of the patella.

Fracture of the neck of the femur, though occasionally seen, is much rarer in animals than in men, because in animals the neck is less well marked. Schrader reports a case; the articular head had again become adherent to the femur opposite the lower trochanter. Kitt discovered post-mortem a fracture of the neck of the femur and the formation of a false joint; the horse had nevertheless worked at a walking pace. Colin saw fracture of the neck and luxation of the femur in a horse. Fracture of the articular head itself is commoner; Dieterichs even saw a horse with double-sided fracture of the head of the femur. Fractures of the trochanters are rare, though Möller once saw the lower trochanter fractured by a fall on rough ground. Fractures of the lower articular processes, sometimes intra-capsular, are also infrequent, though they have been reported. In dogs the shaft is oftenest broken, usually near the lower end. Comminuted fractures may occur. Greve found a horse's femur broken into eighty-five pieces. In a race-horse the upper portion of the shaft of the femur was found to be broken into many pieces. Fissure of the femur in the horse has been produced by a kick. Fiedler saw a foal with separation of the upper epiphysis from the diaphysis and luxation of the femur.

The symptoms of fracture, of either the shaft, head or neck of the femur, are generally well marked. The animal is very lame both when placing weight on the limb and when advancing it, the limb itself is easily moved, especially in an outward direction (abduction), and crepitation usually exists, though if the fractured portion be much displaced, crepitation may be wanting. As a rule, the "slouching" movement of the entire limb may be remarked, even from a distance, and the only difficulty is to say whether the fracture is in the femur or in the tibia.

The diagnosis of fracture of the upper end of the femur is sometimes difficult, because of the lower portion of the bone becoming inserted into the articular cup and thus supporting the weight of the body; in such cases, however, the limb is, as a rule, visibly shortened.

Fracture of the great trochanter is followed by swelling and marked lameness when the limb is carried, slowness in movement, shortening of the forward stride, and, usually, by abduction of the limb; later, while lameness continues, there is atrophy of the gluteal muscles and a depression over the trochanter. Fracture of one of the lower condyles produces severe localised pain and marked flexion of the limb, similar to that of inflammation of the stifle-joint (gonitis); the other symptoms of stifle lameness develop during the next few days.

In horses and cattle the **course** is generally unfavourable, particularly if much lameness is shown when weight is placed on the leg. Fractures of the diaphysis may be followed by death from bleeding if the femoral artery be injured. Osseous union never occurs in fracture of the head or neck of the femur. Hess and Schwerdtfeger kept cases of fracture of the articular head under observation for one year and for six months respectively; in neither was there any bony union between the head and shaft. Even where union occurs, the animal remains lame, owing to deformity, and injury of the articular cup by the friction of splinters of bone; the articular cartilage may be completely rubbed away. Fractures of the lower condyle take a very unfavourable course. In small animals fractures of the diaphysis are more promising if there is no great displacement or shortening of the limb. Unfortunately, in dogs these two symptoms are generally marked, the upper fragment being thrust backwards through the muscular tissue, the lower one forwards; the mass of muscle thus interposed renders callus formation difficult, or altogether impossible. Recorded observations show, however, that even in large animals recovery is not entirely out of the question. Wilhelm, indeed, saw a fracture of the femur unite, though the horse was at the same time suffering from fracture of the os pubis of the other side. After ten weeks in slings the horse resumed light farm-work, though the injured limb had become three inches shorter than the other limb. Fracture of the diaphysis in dogs is sometimes followed by formation of a callus fibrosus and permanent lameness, sometimes by perfect bony union and soundness. Fractures of the shaft are less serious, and unite most quickly in swine and small ruminants, which are better able to rest the limb. Fractures of the trochanters are least dangerous, as they do not prevent the animal standing on the limb, and therefore are not likely to induce laminitis in the opposite foot; but even they sometimes give rise to permanent lameness, which restricts the animal to slow work. The **prognosis** must largely depend on the degree of lameness

associated with the fracture. Heuberger, in a horse, saw complete union of a fracture of the upper trochanter.

Treatment is confined to resting the animal, and if a horse, to placing it in slings. The methods of reduction often described are usually inadmissible; even in dogs the muscles of the quarter are comparatively powerful, and oppose great resistance to manipulation. The extension and counter-extension recommended often result in thrusting the fragments further apart. In dogs it is best to approximately replace the parts, and then to apply a plaster bandage, starting from the metatarsus and extending as high up the limb as possible, fastening it in position by a so-called "saddle." The bandage is passed over the back and around the limb of the opposite side, to prevent it slipping down. This method often succeeds in dogs, but also at times fails. In man, and also in dogs, surgeons have been successful in curing fracture by screwing together the portions of the shaft of the femur with silvered steel screws. By observing strict asepsis the wounds heal readily and the fracture reunites.

In larger animals both reduction and retention are much more difficult, though the former is to some extent assisted by anæsthesia. The bandages and dressings which are often described can seldom be adjusted in such a way as to give a secure hold without setting up injurious pressure. Unfortunately, at the present day, consideration of economy generally renders treatment out of the question.

Ruminants and swine require rest and a comfortable stall, with plenty of litter like peat-moss, and, to prevent their being annoyed by others, pigs should be placed in separate stalls.

To prevent fracture of the femur when casting horses the so-called "leg twitch" can be strongly recommended. A strong cord is passed round the leg about 6 or 7 inches above the hock, a strong stick 2 feet in length pushed through it, and the cord twisted tight, so as to press the Achilles tendon against the tibia. Any attempt to extend the limb gives considerable pain on account of the pressure of the twitch, and the animal soon ceases to make further efforts. In addition, the twitch directly checks the action of the extensor.

In an old horse with recent fracture of the lower trochanter of the right femur the forward stride was shortened about a quarter of its normal length. As the animal carefully avoided bending the stifle joint, the toe grazed the ground. In advancing, the stifle described a curve outwards, though the upper part of the limb was adducted. When weight was thrown on the diseased limb, or when the right fore foot was lifted, the opposite quarter sank until the

external angle of the left ilium was about two inches lower than the right. At the point where the lower trochanter should have appeared, a depression about as wide as three fingers was visible. On careful examination the lower trochanter could be detected just in front of the biceps femoris ; a weak crepitation sound was produced by moving it. As the horse was not brought back after the first examination, its further progress could not be observed.

III.—LUXATION OF THE FEMUR.

IN the horse the depth of the articular cavity and strength of the ligamentum teres tend to prevent displacement of the femur. Rigot and others altogether deny that displacement occurs, though recorded cases clearly show that it may occasionally happen. It is certain that complete luxation cannot occur without rupture of the ligamentum teres. The pubio-femoral ligament derived from the prepubic tendon of the abdominal muscles sometimes remains intact after luxation, but the capsular ligament and surrounding muscular tissue are always ruptured. Incomplete luxation can scarcely occur in the horse, and reported cases in the cow are open to doubt.

In the horse the neck and articular head are more easily broken than displaced, but in oxen and other animals the conditions rather favour luxation, the articular cavity being flatter, and the ligamentum teres weaker. Luxation of the femur occurs in dogs. Fiedler noted a case in a foal, where the epiphysis was also separated.

In making post-mortem examinations of horses, Falke repeatedly found the ligamentum teres ruptured. In an old animal that had shown no lameness prior to death, the ligamentum teres was absent. The points where the ligament is inserted into the head of the femur and acetabulum appeared deepened and smooth, but not a trace of the ligament was visible, and the pubio-femoral ligament, though normally developed, ended before entering the joint-cavity. The transverse cotyloid ligament was normally developed ; the posterior portions of the gluteus parvus were interspersed with connective tissue. Probably luxation or violent distortion of the coxo-femoral joint had long before taken place, causing rupture of the ligamentum teres and of the muscle. Falke, experimenting on dead bodies, found that luxation was in one instance produced by a pull of 8 cwt., and in another of 16 cwt. In each instance the head of the bone and the cotyloid cavity remained intact, but the ligamentum teres and the capsular ligament were ruptured. It is therefore quite certain that the femur may be luxated without injury to the articular surfaces. Bucher's observations show that rupture of the ligamentum teres is often followed by severe lameness. Two horses which he saw with this rupture were unable to support weight on the diseased limb. One rested the point the other the side of the toe, on the ground ; the hock was excessively

extended, and the phalanges fixed in a position of marked plantar flexion. It is uncertain, however, whether these symptoms were exclusively dependent on rupture of the ligamentum teres. Wyman and Lusk saw complete luxation of the femur in a mule.

Amongst the **causes** are violent movement of the limb on the hip-joint, excessive flexion or extension in falling, and sometimes excessive lateral movement (ab- and ad- duction). The head of the bone, in quitting the acetabular cavity, does not always move in the same direction, but may take a variety of positions, giving rise not only to peculiarities in the symptoms, but influencing prognosis and treatment.

Symptoms. The displaced limb is sometimes lengthened, sometimes shortened, sometimes fixed in a position of adduction, sometimes in one of abduction. Its mobility in certain directions may be limited, whilst in certain others it may be abnormally increased. This resistance to manipulation distinguishes luxation from fracture, a distinction which is strengthened by the absence of crepitation. In any case, freedom of movement is lost. Luxation is always accompanied by marked lameness when the limb is carried (swinging leg lameness), though there is also more or less inability to sustain weight.

After a time the hip-joint appears swollen, though occasionally swelling is replaced by a depression, whilst the upper trochanter appears displaced, being sometimes more prominent, sometimes sunk in the masses of muscle. The skin over and around the hip-joint is either very tense or abnormally loose. When the bone is displaced into the obturator foramen, its head may be felt from the rectum or sheath, and is especially distinct when the limb is moved.

Prognosis is always doubtful, and in large animals generally unfavourable. Only during the first three days is reduction usually possible, and then is effected with the greatest difficulty. If attempted early, it sometimes succeeds in small animals. After rupture of the ligamentum teres in large animals, relapses are very common; recovery is then exceptional, and the animal's usefulness is seldom restored. In old-standing cases, muscular contraction furnishes a further impediment to reduction.

Cunningham succeeded in replacing the bone in three cows; recovery followed. In the case of two horses, however, he was unsuccessful. Teetz reduced a luxation of the femur in a goat, although treatment only commenced three weeks after the injury.

Treatment. Large animals are cast on the sound side and anæsthetised; and, as the operator's strength is not sufficient to

extend the limb, it becomes necessary to use mechanical aids. Extension once effected, it remains for the operator to effect reposition. This may sometimes be done by abduction, sometimes by adduction and rotation of the limb, though, as a rule, the latter is impossible of accomplishment. In Ranson's case the procedure was to place a thick, round piece of wood between the horse's thighs, thrusting it up as near the pubic region as possible, and by pressing strongly on the tibia to convert the limb into a lever of the first order, and so raise the displaced head of the femur. The operator, with his hand on the head of the bone, then directed the limb to be moved backwards or forwards with the object of bringing the head over the cotyloid cavity. In Ranson's case a sharp movement, accompanied by a loud "click," announced the return of the head to its proper position. The animal at once regained control of the limb. In smaller animals, like dogs, extension and counter-extension may be left to an assistant, whilst the operator, having taken note of the abnormal position of the caput femoris, effects reposition.

After successful replacement, the horse should be slung to prevent it lying down, which might cause a relapse. Prolonged rest is absolutely necessary in all animals.

IV.—INFLAMMATION OF THE HIP-JOINT (COXITIS).

WITH the exception of the elbow-joint, the coxo-femoral articulation seems least of all subject to disease processes, and in horses is seldom affected, though in them, and still more frequently in cattle, displacement, accompanied by partial or total rupture of the ligamentum teres and of the capsular ligament does occur. In some of Harms' collected cases (cattle) the head of the femur showed abraded spots. Eberhardt also reports cases in cattle where the post-mortem showed rupture of the ligamentum teres and of certain muscles around the hip-joint.

Contusion of the hip-joint follows falls on rough, hard ground, though the bursa of the gluteus medius is then more apt to become inflamed.

Spontaneous inflammation of the hip-joint is a rarity. In oxen double-sided purulent coxitis was seen by Noak, probably from embolism following traumatic pericarditis. In navel-disease in foals, purulent inflammation of the joint sometimes develops. In cattle, as in men, some cases of suppuration in the hip-joint are due to tuberculosis.

The chronic inflammation termed *malum coxæ senile*, so common

in men, is exceedingly rare in animals, though Falke's observations show that it does occur. Schrader, who specially studied this form of disease in horses, also describes it as very rare. It is seldom recognised, even post-mortem.

Symptoms. Lameness is more or less severe, depending on the degree of inflammation. In cattle the diseased limb is extended with the toe turned outwards. The gait is of a rolling character, the limb being directed outwards and carried forward in a semicircle. It is apt to collapse under the animal, especially when turning on the diseased side. In the horse the symptoms are similar. As a rule the quarter is tilted and atrophied, the animal moves diagonally, or away from the lame side, the limb is abducted, and in harness work the leg and shaft on the sound side show marks of friction. Suppuration is notified by great increase of lameness and cellulitis in the region of the joint.

Course. The cases of hip-joint disease in cattle seen by Harms generally took an unfavourable course. A few improved, but none completely recovered. If lameness be marked, it is best to slaughter the animal. In horses, contusion of the hip generally terminates in recovery in about fourteen days, but arthritis and disease of the ligamentum teres are incurable.

Treatment. Rest is of the first importance. If necessary, the animal may be slung, otherwise it should be provided with abundant bedding.

Recent contusions and strains, if accompanied by severe pain, are treated with cold applications. If, after a week, there is no marked improvement, a biniodide of mercury blister may be resorted to. Setons and firing are also useful, though their efficacy chiefly depends on the rest which they enforce.

V.—INFLAMMATION OF THE BURSA OF THE GLUTEUS MEDIUS TENDON.

Anatomy. The *M. gluteus medius*, which represents an extension of the *M. longissimus dorsi*, is, in the horse, inserted on the femur by two tendons and a muscular slip. One of the tendons is attached to the summit of the great trochanter, the other plays over the ridge in front of the same trochanter by means of a synovial bursa, and is attached below to the crest. In horses, inflammation of this bursa or the tendon produces a peculiar lameness, which was first described by K. Günther, and afterwards by Reynard and others. In England the disease has been called trochanteric (Williams), or false hip-joint lameness.

Causes. This disease, which is not uncommon in horses, may be caused by bruising of the bursa, or violent strain of the tendon.

Bruises are produced by falls, by collisions with the carriage-pole, by blows with heavy bodies, strains resulting from heavy draught-work and by falling with the hind limb bent under the body, or when the animal catches the heel of one of the hind shoes in the collar shank. Sudden reining-up is also said to produce it. Horses with sloping quarters and slight muscular development seem predisposed to such injuries.

Course. The disease consists in a bursitis or tenositis, acute or chronic, the tendency always being towards a chronic condition; but the issue depends to some extent on the initial injury, and on the treatment adopted. Under appropriate treatment, lameness may disappear in four to six weeks; but if neglected, and especially if the primary injury be severe, the condition may become chronic.

The prognosis depends chiefly on the stage attained and the severity of the disease. When lameness is recent and slight, and the animal can be rested, there is good hope of recovery, but this is less in heavy draught-horses and in riding-horses than in such as are occupied in the lighter forms of draught. Marked wasting of muscle, the existence of swelling, and severe or chronic lameness render prognosis doubtful; and where there is periostitis and exostosis, with abrasion of the cartilaginous covering of the bone, there can be little chance of recovery. The suggestion that the bursa sometimes communicates with the hip-joint, and that disease may extend to the latter, seems based on insufficient knowledge of anatomy.

Symptoms. In recent acute inflammation there is increased warmth, swelling and pain on pressure over the great trochanter. When resting, the limb is usually flexed, though sometimes no change can be detected until the horse is exercised. When moving, the forward stride is shortened; less frequently, there is a tendency to lift the limb before the last phase of the stride is complete. The animal generally moves obliquely, as does the dog, the sound side being thrust forward, and the lame limb dragged and rotated more or less inwardly. By placing the hand on the middle trochanter during movement distinct crepitation may sometimes be detected (*tendovaginitis crepitans*); at a later stage the muscles of the quarter become atrophied.

The slighter, and especially the chronic, forms of lameness are often only apparent when turning or when moving heavy loads, the horse then drawing with the sound leg, and endeavouring to shorten the period of loading of the diseased one.

Similar symptoms, however, are seen in other diseases, such as old cases of fractured pelvis; the diagnosis must therefore be

based principally on the local changes. The crepitation sound is the most trustworthy, for both the swelling and pain may be caused by injury to the upper trochanter.

Treatment. Recent cases, exhibiting acute inflammatory symptoms, are best treated by absolute rest, and cold applications, such as douches or refrigerant lotions. Where bruising of the hip is plainly marked, warm fomentations may be more beneficial. Blisters may afterwards be used, and, if unsuccessful, can be followed by setons; the actual cautery has been employed with good results. Rest should be continued for some time after the disappearance of lameness; too early return to work is liable to be followed by relapse. Some horses only recover sufficiently for light draught.

VI.—PARALYSIS OF THE HIND LIMB.

THE muscles of the hind limb receive their nerve supply from the lumbo-sacral plexus. The principal nerves are (1) the iliaco-muscular, (2) anterior and posterior gluteal, (3) anterior crural, (4) obturator, and (5) the great sciatic. The iliaco-muscular nerves supply the psoas and iliacus muscles; the anterior gluteal nerves furnish branches to the three gluteal muscles and the tensor vaginae femoris; the posterior gluteal supply parts of the superficial and deep gluteal muscles, the biceps femoris, the skin at the back of the thigh 4 or 5 inches below the tuber ischii, the semi-tendinosus muscle, and give off a branch to the internal pudic, which supplies the perineum.

The anterior crural, the second largest nerve of the plexus, descends between the psoas muscles to supply the sartorius and quadriceps extensor cruris. It also furnishes sensory twigs to the inner surface of the thigh. The obturator nerve follows the artery of the same name downwards and backwards to the obturator foramen, through which it passes resting in a groove on the antero-external margin, and on emerging from the pelvis it supplies the obturator externus, adductor parvus, adductor magnus, pectineus and gracilis muscles.

The great sciatic nerve gives branches to the obturator internus, pyriformis, gemelli, quadratus femoris, semi-membranosus, lower portion of the biceps and semi-tendinosus muscles; opposite the small sacro-sciatic opening it gives origin to the external popliteal nerve, and, towards the upper end of the gastrocnemius muscle, the external saphenous nerve. The great sciatic is continued as the internal popliteal, which is again continued by the posterior tibial nerve. The external popliteal, after furnishing a branch to the biceps femoris, divides into the musculo-cutaneous and anterior tibial nerves, which supply the extensor pedis, extensor brevis, peroneus and flexor metatarsi muscles. The internal popliteal nerve supplies both heads of the gastrocnemius, the soleus, popliteus, perforatus, perforans, and flexor accessorius muscles. It is the sensory nerve for the lower portions of the hind limb.

A. Paralysis in the region supplied by the gluteal nerves.

Few recorded cases of this kind exist. Franke reports an instance

of paralysis of the anterior branches caused by a neuroma. The patient, a seven-year-old gelding, showed gradually advancing atrophy of the gluteal muscles of the left side, which became so marked in five months as to result in the bones being almost denuded of muscle and appearing almost like an osteological preparation; the muscles of the thigh and lower thigh also suffered severely. At first there was only insecure gait, but this symptom, always marked when the horse was turned, gradually became aggravated. Finally the lower part of the limb was kept permanently flexed, and, during forced exercise, was slid along the ground and set down with a tapping, insecure movement. The backward portion of the stride was shortened. On post-mortem examination a neuroma the size of a pigeon's egg was found on the anterior gluteal nerve 4 inches from its point of exit.

Roloff described a similar case. Here, however, the horse became lame suddenly, and carried the affected limb too near the middle line, as well as extending it too far forwards. In time the muscles of the quarter wasted to a great extent. It seems probable, however, that in this case the posterior gluteal nerves were paralysed, as suggested by the abnormal adduction of the limb.

B. Paralysis in the region supplied by the great sciatic nerve.

Paralysis of the great sciatic nerve.

Paralysis of this nerve has been observed in horses and dogs. The **causes** are: lesions in the course of the nerves, or disease of the spinal cord or brain. Disease of the spinal cord usually produces double-sided paralysis. In horses sciatic paralysis may result from falling on the haunches, slipping in heavy draught, forced extension of the hind limbs, compression of the nerve by tumours, or exostoses, or from systemic infection; in dogs the usual causes are falling from a height, severe bruising of the hind-quarters, and neuritis following distemper. Albert found, on post-mortem examination of a horse which had been treated for three months without effect, the residuum of a blood extravasation surrounding the nerve at the point where it left the pelvic cavity. The tissues below this point were atrophied, and the muscles, especially the *M. rectus femoris*, had undergone extensive fatty degeneration.

In addition, paraplegia is by no means uncommon in dogs, and even in horses; in the hind limb the great sciatic nerve is affected, and in the opposite fore limb the axillary plexus. Such cases are clearly of cerebral origin. The condition described by Beel as paralysis of the hip nerves appears to have been paraplegia. Friis saw paralysis of the right fore and left hind limbs, which was not

improved after three months' treatment. The absence of anæsthesia and of muscular atrophy pointed to its cerebral nature.

Symptoms. Paralysis of the great sciatic is accompanied by general lameness or complete inertia of the limb, the muscles involved including the biceps femoris, semi-membranosus and semi-tendinosus, and in consequence the limb is no longer capable of free movement. The limb hangs limply from the hip downwards, the tendo Achillis is relaxed, and neither hip, stifle, nor hock can be voluntarily flexed. On enforced movement the lower part of the limb is jerked upwards

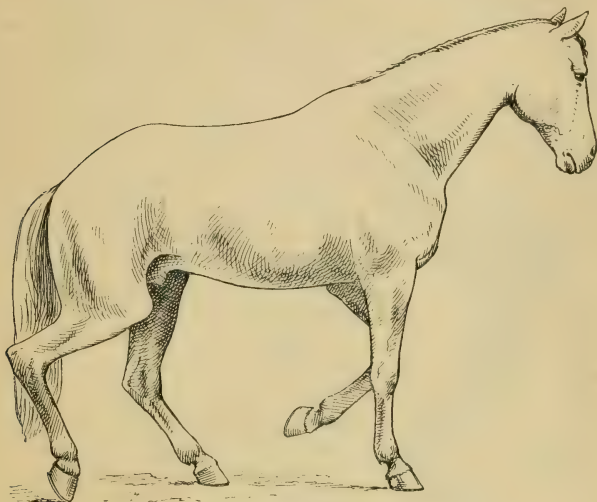


FIG. 521.—Paralysis of the anterior crural nerve.

and forwards by the sudden contraction of the extensors of the stifle, the foot with the phalanges bent is dragged on the ground, and in dogs, the dorsal surface of the toes is soon rubbed raw. Backing is very difficult, the fetlock coming in contact with the ground. When, however, by external help the limb is placed in its normal position, it is able to sustain weight in the usual way, because the extensors of the stifle fix that joint, and with it the other joints of the limb. Anæsthesia of the skin of the lower parts of the limb accompanies this condition.

Möller saw three cases of sciatic paralysis in dogs, one in a St. Bernard, one in a bull-dog, and one in a working-dog. (In Berlin, and

throughout Germany, large numbers of dogs are employed for drawing light carts, sometimes singly, sometimes in pairs. They are of no determinate breed, and vary from the size of a collie up to that of a boar-hound.) In one case the dog had fallen from a window, and at first showed complete paraplegia, which, however, disappeared after a few days, leaving one limb affected with sciatic lameness, which also disappeared soon afterwards. The second dog became affected during convalescence from distemper, and in the third the lameness had no apparent cause.



FIG. 522. —Paralysis of internal popliteal nerve.

Möller has seen and described one case of paralysis of the **internal popliteal nerve**. In this disease the muscles lying at the posterior surface of the tibia are affected; plantar flexion is impossible, that is to say, the hock cannot be extended nor the foot flexed (in the plantar sense). As, however, in the horse flexion of the hock brings both flexors of the foot, and especially the tendon of the flexor pedis perforans, into tension, the phalanges are, in this lameness, necessarily fixed in a position of plantar flexion. This is especially noticeable when the animal stands on the paralysed limb, because the hock is then excessively flexed. It is still possible, however, to place weight on the limb, because the Achilles tendon fixes the hock.

The limb is advanced with all the joints excessively flexed, the foot being lifted very high, and set down with a hesitating ("tapping") movement; the action as a whole bearing some resemblance to stringhalt. The condition is clearly due to paralysis of the muscles at the back of the lower thigh. The gastrocnemii are unable to extend the hock, whilst the flexor metatarsi is passive, and only affects movement through the medium of its peculiar tendinous apparatus (see "Rupture of the Flexor Metatarsi"). Trotting is impossible.

The muscles at the posterior surface of the thigh, particularly the gastrocnemii and flexor pedis perforans, are relaxed, and afterwards become atrophied. Paralysis in this case appears to have been due to

anatomical changes in the nerve in its course between the gastrocnemii muscles.

Nocard saw fractured pelvis in the horse produce symptoms closely simulating this lameness.

As an experiment, Möller divided a horse's internal popliteal nerve just before its point of entry between the gastrocnemii. The animal at once assumed the position above described, the fetlock-joint showing plantar flexion and the foot being excessively raised during the forward stride, though not quite in the same awkward way as in the other case, in which the immediate cause of the paralysis was perhaps more centrally situated.

The prognosis in all cases of paralysis should be guarded. It varies with the causes which have produced the condition. In recent cases, where the only discoverable cause is exposure to chill, and in those due to falls or strains, the prognosis is more favourable than in old standing cases with marked muscular atrophy. In incomplete paralysis the forecast is more favourable, but in complete sciatic lameness the outlook is bad, especially if there be local anæsthesia. Recovery is still possible where sensibility and irritability to the Faradic electric current is preserved. Though Möller's case of internal popliteal paralysis appeared incurable, the case of sciatic paralysis in the dog produced by a fall improved so much in fourteen days as to warrant expectation of complete recovery. The two other cases were removed from observation, but appeared favourable, the disease not being of old standing.

Treatment is seldom very satisfactory. Strychnia, glycerophosphates, and formates may be administered with advantage in some cases. Locally, counter-irritation, massage and electricity may be tried.

C. Paralysis of the external popliteal nerve.

Paralysis of this nerve has been frequently observed in horses. In some cases, there may be a history of injury to the animal, contracted by running away, by slipping when galloping on wet pasture, or by falling when leaving a railway horse-box. Sometimes this paralysis follows a severe attack of strangles, difficult parturition, fracture, or lacerated wound of the thigh; but often there is no knowledge of accident to the animal, or visible sign of wounding or bruising of the affected leg.

The lameness is distinguished by symptoms of partial or complete loss of power in the flexor metatarsi and the extensor muscles of the foot. At rest, the limb may appear normal, bearing weight with the foot resting naturally; or the stifle may be drooped, the hock

extended, and the fetlock and front of the pastern resting on the ground. In advancing, the limb appears to dwell, becoming rigidly extended backwards, and then dragged forwards, renewing contact with the ground by the flexed fetlock or the plantar surface of the foot. In backing, at first the fetlock is straightened and the heels come to the ground, then the foot is drawn stiffly backwards, the fetlock is suddenly shot forwards and the heels are raised from the ground. At liberty in a field, the patient can canter, trailing the defective limb, which touches the ground by the front of the fetlock and toe-wall of the foot.

Goubaux gave an excellent description of paralysis of the external popliteal nerve as early as 1848. His case was caused by a violent contusion, and was unsuccessfully treated by repeated blistering along the course of the nerve.

Szidon states having seen paralysis of the external popliteal nerve consequent on injury by small shot.

An interesting case of this kind has been recorded by Möller. An eight-year-old Belgian gelding was one morning found lame in his stall without visible cause. Seen next day, he exhibited marked uncertainty in moving his hind limbs, suggesting partial paralysis, but it soon became evident that only the right hind limb was affected. Whilst the left hind limb was moved and weight was placed on it in the usual way, the right leg was carried close to the middle line of the body (adducted) and was placed too far in advance and too near the right side, causing the animal to fall towards the right side; the body was only saved from coming to the ground by a rapid spring with the left foot. At the same time the stifle and hock joints were excessively extended, and the phalanges flexed (plantar flexion). The gait was clumsy and insecure in the highest degree. These movements recurred at every step; the animal was incapable of trotting. The uncertainty of walking was aggravated by the abnormal flexion of the phalanges, which at times caused the animal to walk on the front of the fetlock-joint itself.

By passing a rope round the right fetlock, and so drawing the limb outwards and extending the fetlock each time the animal attempted to move, walking became perfectly easy. Immediately such assistance was withdrawn, however, the previous difficulties returned. At first no anatomical change in the limb could be noted, nor was there any sign of local pain or inflammation, but by placing the hand on the limb during movement, the muscles in front of the tibia, as well as the semi-tendinosus, semi-membranosus, and biceps femoris were found to remain relaxed and without movement. Sensation in the

lower parts of the thigh and about the phalanges was also impaired. The animal, however, regularly reacted to stimuli in the region of the quarter and upper thigh.

Three weeks after the first appearance of lameness an inflammatory swelling appeared between the anus and tuber ischii, showed fluctuation, and on incision discharged about two quarts of very offensive lumpy pus. After enlarging the orifice, the hand could be introduced into an extensive cavity consisting of several divisions, some lying between the muscles of the quarter, some in the paraproctal

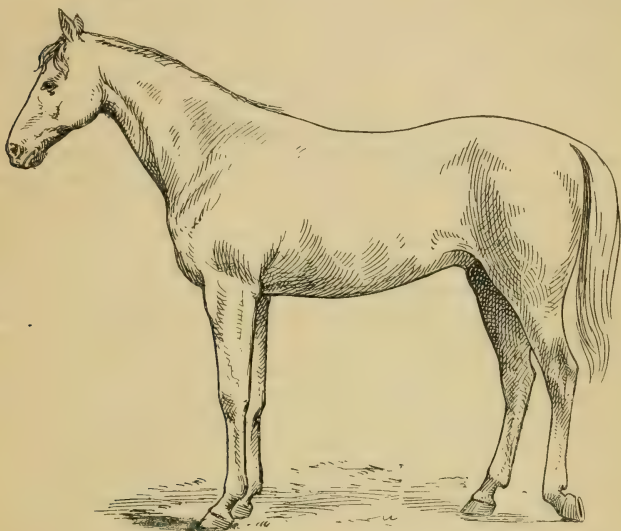


FIG. 523.—Paralysis of the external popliteal nerve.

connective tissue. Except for compression by the abscess, the rectum seemed to have escaped any disease change. As the abscess cavity closed, the difficulty in movement gradually diminished though the gait for long remained uncertain, especially when the horse was on uneven ground, the phalanges failing to be extended and the animal “knuckling” at the fetlock. At this stage the animal passed from observation.

There can be no doubt that the abscess originated in the paraproctal connective tissue in consequence of infection from the rectum. It then extended between the muscles of the quarter and pressed on the great sciatic nerve, so that both the external and internal popliteal

nerves were affected. The symptoms due to injury of the external popliteal were more marked because the function of the muscles supplied by the internal popliteal (gastrocnemius, flexor perforans, perforatus, &c.) was partially replaced by their tendinous apparatus; this explains why weight could still be borne on the limb.

The prognosis should be reserved. It is more hopeful where the loss of power arises from bruising or evident local injury; but in most cases complete recovery is problematical.

Treatment. For a few weeks at the beginning rest should be prescribed; later, progressive exercise may be encouraged. Counter-irritation applied over the affected muscles and those which appear atrophied, followed by massage of the region, is often beneficial. Bouley cured one case, and Cadiot another, in three weeks, by blistering and exercise. Turning the patient into a small paddock for two or three months, after blistering, has given good results.

D. Paralysis of the anterior crural nerve and quadriceps femoris muscle. Rupture of the rectus femoris and vasti muscles, and of the straight ligaments of the patella.

Though paralysis of the crural or anterior femoral nerve is not common, yet in animals it occurs oftener than is generally believed. Sometimes it accompanies hæmoglobinuria, sometimes it is produced by strain, by partial rupture following on falls, or by violently kicking backward. Möller saw six cases in horses drawing heavy loads, and many more, as a sequel to hæmoglobinuria. Its connection with this disease is explained by the fact that the crural nerve passes between the psoas and iliacus muscles, which in hæmoglobinuria seem particularly involved. Although it is possible that myopathic lameness of the rectus and vasti muscles occurs in hæmoglobinuria, yet the greater number of such cases are probably due to disease of the nerve indicated, because in nearly every instance the loss of function and excessive atrophy are common to all the muscles attached to the patella, and in a similar degree, a condition scarcely to be expected in a purely muscular disease. The sudden onset and equally rapid disappearance of the disease, as well as the total want of inflammatory symptoms, support this view. Where disturbance of sensation on the inner surface of the thigh exists, there can be little doubt of the nature of the disease. Goubaux experimentally divided the nerve high up in the thigh, between the vastus internus and rectus femoris, and thus obtained all the symptoms of muscular paralysis peculiar to hæmoglobinuria. Other conditions, like psoas abscess, tumour formation, hæmorrhage, &c., may also destroy the function of this nerve temporarily or permanently.

Though post-mortem examination sometimes shows the rectus and vasti muscles in a marked state of fatty degeneration after this disease, that fact in no way proves the condition to have been myopathic lameness, as has been suggested.

Symptoms. In consequence of loss of power in the sartorius and extensor muscles of the stifle, weight cannot be supported by the paralysed limb, which, at rest, appears drooped at the quarter, flexed at the stifle and hock, with the foot, carried a little forward, resting on the toe. In movement, attempts to sustain the body on the affected limb are at once followed by flexion of all the joints, including the phalanges. The weakness of the stifle is very marked. The skin on the inner surface of the thigh loses its sensibility, and later and gradually the patellar muscles undergo atrophy, while the adductors of the thigh become hypertrophied.

In incomplete crural paralysis the body sinks towards the affected side, whilst all the joints become somewhat flexed (Fig. 524), the last period of the stride being consequently shortened. Animals suffering from this disease learn to move better, however, in time, the ab- and ad- ductors of the limb co-operating to fix the stifle-joint. This action is easily detected when the animal is walked very slowly past the observer: it is then seen that the upper end of the tibia is not only drawn backwards and upwards, but the patella is fixed on the condyles of the femur. The last symptom to disappear in convalescence is the upright position of the os suffraginis, a consequence of incomplete action of the rectus and vasti.

Paralysis of the crural nerve or of the above muscles may be mistaken both for muscular rupture and for lateral luxation of the patella (*vide loc. cit.*). Ruptures in the various extensors of the patella have been seen by numbers of practitioners. Delwart saw three cases of rupture of the rectus femoris in the horse, all caused by slipping or falling; two proved incurable. The symptoms resembled those of the above-described paralysis. Not infrequently a depression could be detected in the muscle. Post-mortem examination showed the muscles to be pale, as though boiled, their fasciculi shredded out and partly separated.

Schmidt describes rupture of the vastus externus. A horse had trodden in a deep rut, and, the ground being frozen, was unable to withdraw its foot without assistance. Severe lameness was immediately apparent, the limb was relaxed, and collapsed at every attempt to sustain weight on it; the stifle and hock were markedly flexed. At first no change could be detected in the muscles, but after some days a depression, about 4 inches deep, became visible on the outer side of the muscles attached to the patella. The horse was unable to rise for fourteen days, but in three weeks' time could again place weight on the limb. In two months it was put to light work, and in three months had entirely regained its usefulness. During its course this case also showed some resemblance to crural paralysis, and it is possible that it may have been of that character.

Hollmann saw rupture of the rectus femoris muscle in a cow, followed by permanent lameness; Haubner described injuries to the extensors of the patella in a horse. Meyer saw rupture of the rectus femoris, and both vasti muscles in a cow: a distinct depression could be detected about 8 inches above the patella. The symptoms were similar to those of crural paralysis.

Rupture of the straight ligaments of the patella has been seen in horses. Möller saw two cases of rupture of the external straight ligament—in one due to a collision with a carriage-pole, in the other, apparently to slipping in the stable. Both animals showed inability to bear weight on the limb (supporting leg-lameness). At first the animals could not stand on the

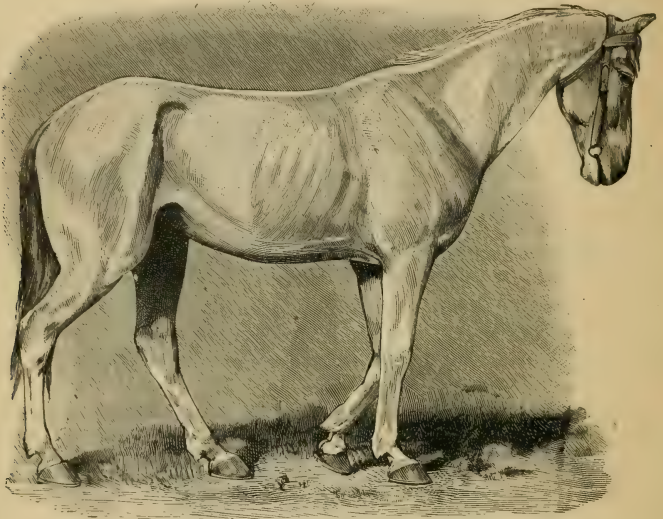


FIG. 524.—Incomplete crural paralysis (from an instantaneous photograph).

affected limb at all, and later only to a certain extent. Below the stifle only the middle and inner straight ligaments could be felt; in place of the outer was a depression. Pressure at this part caused lively pain. After complete rest for three and four weeks respectively, the horses improved sufficiently to return home.

Voigtländer confirmed his diagnosis of rupture of the straight patellar ligaments in an ox by post-mortem examination. The inability to stand, severe inflammation of the stifle-joint, marked flexion of the limb, and inability to extend or bear weight on it, and the relaxation of the affected ligaments, left little doubt of the character of the injury, even during life. Voigtländer saw a cow with rupture of the inner and middle straight ligaments, and of the inner lateral ligament, and outward luxation of the

patella. The condition had resulted from one cow attempting to mount another.

Course. Whilst the paralysis accompanying hæmoglobinuria is generally obstinate, indeed sometimes incurable, that produced by severe mechanical strain occasionally disappears in a few days. Möller saw three cases of the latter kind recover in six, twenty, and forty-two days respectively, and two others after a short interval; one case appeared incurable. When this paralysis is complete and the horse can only be kept standing in slings, recovery is usually hopeless; but recent and partial crural paralysis, however caused, may be expected to make a useful recovery. Dollar and others have seen complete recovery from the paralysis following hæmoglobinuria, though the cases have lasted many months. The horses were turned out to grass.

Treatment of crural paralysis must follow general principles. The use of the electric current, and especially of the Faradic current, is very difficult in the horse, and can seldom be advantageously resorted to. The position of the crural nerve also prevents its being directly reached, and treatment is therefore confined to, as far as possible, checking atrophy, and improving nutrition in the paralysed muscles. Massage, in the form of kneading and beating, is of great value for this purpose, and should, if possible, be applied daily. In obstinate cases Dollar has several times had excellent results from deep point firing over the affected region. Repeated blistering is useful. Exercise, in addition to favouring regenerative changes in the affected nerve, assists circulation and nutrition in the muscles. In dogs the induced electric current may be employed. Intra-muscular injections of veratrin or strychnine, and iodide of potassium and strychnine administered internally have also been recommended.

The treatment of ruptures consists in absolute rest, the provision of plentiful bedding, and in turning the animal with sufficient frequency to prevent bed-sores; in some cases slinging the horse may be advantageous.

E. Paralysis of the obturator nerve.

Obturator paralysis has several times been reported as following tumour formation in the course of the nerve, especially in grey or white horses, the subjects of melanosis. It is characterised by loss of function in the adductors, the pectineus and gracilis muscles, and inability to adduct the limb. The condition sometimes is diagnosed with difficulty, because it presents none of the marked symptoms seen in other paralyses, and because its occurrence is frequently marked by symptoms of pubic fracture, in which, owing

to callus formation, the obturator nerve may be implicated or undergo compression. Paralysis of this nerve may also be caused by pressure of the foetus in difficult parturition.

Symptoms. At rest the limb may appear normal, but in movement it is strongly abducted, the foot carried outwards, or dragged along the ground. In some cases the pastern is flexed, and backing is very difficult. These symptoms are accompanied, or soon followed, by marked atrophy of the muscles inside the thigh. Diagnosis is assisted by rectal or vaginal exploration.

One recorded case was in a five-year-old mare, which became lame without visible cause. In walking, and still more so in trotting, the right hind foot was strongly abducted. The hip-joint was markedly flexed, and the stifle drawn upwards and outwards, as in string-halt. When backing there was difficulty in moving the right foot, but weight was placed on the limb as usual. Recovery occurred in between four and five months, during which strychnine was administered. The case described by Nocard (see section on "Fracture of the Pelvis") as due to compression of the nerve trunk by the callus, resulting from a fracture through the obturator foramen, was no doubt one of obturator paralysis. There was atrophy of the adductor group of muscles, and a peculiar lameness.

W. Willis has described two cases of obturator paralysis, and referred to others as having been seen. In each instance there existed a swelling, which later developed into a callus over the pubis at the point where the obturator nerve crosses that bone. In mares it could be detected by examination through the vagina. Willis at first diagnosed these cases as "fractured pelvis," as indeed they were. The average duration of the cases appears to have been about three months, and the paralysis appeared to march concurrently with the development of the callus, marked abduction of the limb, its principal symptom, appearing as the soft callus increased in size and diminishing as the callus became smaller and more fully ossified. In one instance, though the animal was able to work, a certain degree of abduction continued for a year.

The prognosis must vary with the cause. It is favourable in cases arising from difficult parturition, but very unfavourable in those due to fracture, or tumour formation, because surgical interference is impracticable. **Treatment** is largely expectant, especially in cases unassociated with gross lesions. Rest, followed after an interval by gradually increasing exercise, and massage of the adductor muscles, may prove beneficial.

VII.—THROMBOSIS OF THE POSTERIOR AORTA AND OF ITS BRANCHES.

ARTERITIS followed by partial or complete obstruction of the lumen, may be caused by emboli, infection, sclerostomes, or by any injury in which the inflammatory process involves the arterial walls. Cases arising in this way, though probably not uncommon, are seldom recognised during life. Partial or complete thrombosis of the posterior aorta or of the iliac arteries frequently occurs in horses, and occasionally a similar condition may be found affecting the brachial trunk, but the cause in either case remains undiscovered. In some instances there is a history of antecedent infectious disease (strangles, influenza), but the connection between systemic disease and the occurrence of aortic thrombosis waits explanation.

Stoppage of small vessels near the femoral or pelvic arteries by emboli of small diameter may produce no serious results, but where large vessels are plugged, the muscles served by them, no longer receiving the quantity of blood necessary for their functional activity, are incapable of sustaining severe exertion, lameness appears, and the horse comes to a standstill, from paralysis of the affected muscles.

Whilst the animal is at rest circulation is maintained by collateral vessels, and it is only on movement that symptoms develop. The time of their appearance depends on the degree of obstruction in the vessels and the intensity of the muscular action. When obstruction is partial, or the vessels are small, the animal may go several hundred yards, even at a fast pace, before lameness appears, and the symptoms vary in character according to the muscles involved, but thrombosis of large vessels is followed by symptoms of extensive muscular inability after even three to five minutes' trotting. A few minutes' rest produces an apparently perfect recovery. The intermittent lameness thus produced is quite distinctive. Thrombi extending to the aorta sometimes prove fatal, as shown by many reported cases.

A remount showed œdematous swelling and inability to stand, first in one hind limb and, on the following day, in the other. On the second night it died, and on post-mortem examination the posterior aorta was found completely thrombosed at its point of bifurcation. The thrombus contained a specimen of *Sclerostomum equinum*. Cases of rupture of the posterior aorta and of thrombosis of the iliac arteries are described at length in Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery." In Rutherford's case the posterior aorta, right external and internal iliacs, and left internal iliac were all thrombosed.

The disease generally develops insidiously, attention being first directed to it by the attacks of lameness, but when large vessels are blocked other well-marked symptoms are present, like dyspnœa, sweating, and cramp in the affected groups of muscles. The thrombosed vessel never again becomes clear, though collateral circulation is sometimes established, and gradual improvement follows. In other cases the lameness increases, in consequence of the increase of the thrombus.

Symptoms. The intermittent lameness, which soon disappears with rest, but always returns on movement, is characteristic. Its severity and extent depend on the position and size of the thrombus or thrombosed vessel. Blocking of the femoral artery is immediately followed by loss of function in the iliac-psoas and tensor fascia lata, which it supplies with blood. Lameness is, therefore, most marked whilst the limb is being advanced. The forward stride is retarded and shortened, and the limb dragged, the reason being that these actions are normally performed by the muscles named.

Thrombosis of the external iliac artery, which supplies the glutei and quadriceps femoris, produces a "supporting leg lameness," which closely simulates crural paralysis. The animal is unable to stand on the limb, because at every attempt the joints become flexed. Paralysis of the glutei is followed by loss of balancing power, and when double-sided by rolling to and fro of the hindquarters. In obstruction of the caudal arteries the tail hangs limply. Horses with double-sided iliac thrombosis rapidly lose control of both hindquarters when galloped. The hind limbs approach one another more and more closely, the hoofs are planted on the ground just alongside of one another, and finally the animal comes to the ground with the hindquarters first.

A rare condition was described by Haas. When first examined the horse showed symptoms of thrombosis of the left iliac artery. Fifteen minutes later, when again moved, the lameness seemed transferred to the right limb. On post-mortem examination there was found extending into the left iliac artery a thrombus, which, however, could easily be carried by the blood-stream into the right. Haas saw thrombosis of the posterior aorta in a cow. Strebel saw a cow which was only capable of standing for a few moments at a time. On post-mortem the cause was found to be thrombosis of the left iliac artery. Proeger saw thrombosis in a cow in consequence of endocarditis.

In bilateral thrombosis, or in thrombosis of the aorta, these symptoms are combined, and may become so severe that the animal is unable to support the hindquarters, even when at rest. Such cases often show dyspnœa, tumultuous action of the heart, cramp in the

muscles of the hindquarters, and, if the animals be worked, epileptiform convulsions of the entire body. Though the rest of the body is bathed in sweat, the affected region remains dry and cold. Sometimes even during rest the limb seems colder than its neighbour. Rectal exploration is valuable in suspected cases of aortic or iliac obstruction.

Stallions are sometimes unable to copulate. Möller saw one in which erections occurred, but were not followed by ejaculation of semen. The post-mortem of such animals shows emphysema of the lungs, with hypertrophy and dilatation of the heart.

According to Terrillon's observations on men suffering from this disease, the attack is accompanied by a feeling of painful stiffness and severe burning. In recent cases, animals evince pain by lifting the limb when standing at rest; soon after, lameness becomes apparent. Möller once saw a primary attack of embolism. The symptoms were severe dyspnœa, laboured action of the heart, frequent pulse, and cramp in the affected muscles.

The prognosis depends on the degree of interference with movement, but the tendency is always towards aggravation of symptoms, not towards improvement, and only in slight cases can the development of an efficient collateral supply and recovery be looked for. Of eleven army horses affected during the year 1891 with thrombosis of the aorta, of its branches, or of the brachial artery, only one recovered.

Treatment. The solution or removal of the thrombus is impracticable, and internal remedies, like potassium iodide and the alkaline carbonates which were formerly recommended, are of little or no value. Massage is dangerous. Though the thrombus may be loosened by manipulating the vessel through the rectum, further coagulation readily occurs, and a case thus treated died next night in consequence, the post-mortem showing complete thrombosis of the posterior aorta with fresh clots. The only treatment of value consists in exciting collateral circulation by regular work. The animal is exercised until the first symptoms of lameness appear, and then rested, or it may be put to continued light work. The increased blood circulation thus excited favours development of collateral circulation, but too much is not to be expected from this treatment.

VIII.—DISPLACEMENT OF THE BICEPS FEMORIS MUSCLE.

IN cattle the biceps femoris or long vastus muscle glides on the great trochanter of the femur by means of a large serous bursa, and its anterior border is firmly embraced by the double laminae of the fascia lata. From varying causes this fascia may become fissured, or unduly stretched, and in consequence the muscle slips backwards off the trochanter, which passes into the fissure, and flexion of the femur is impossible.

The accident happens particularly in emaciated animals with prominent trochanters and in mountain cattle with sloping quarters, and is caused by slipping with the limb extended backwards, in the cowshed, at work, or in coitus.

Symptoms. The lameness is usually confined to one leg. Immediately the muscle becomes fixed behind the trochanter, flexion of the thigh is impossible and lameness is at once developed. The limb is fixed in an extended position similar to that in upward luxation of the patella, or is thrust outwards and forwards with a kind of "mowing" movement, the claws scraping the ground. On local examination, the trochanter appears very prominent and situated directly above a rigid cord which extends parallel with the anterior margin of the luxated muscle. Winkler denies having seen the mowing movement in the twenty cases which came under his notice, but draws attention to the similarity between this lameness and luxation of the patella, from which it is only distinguished by the fact that the limb is not so firmly fixed when in the extended position. Sometimes the dislocation is only momentary, the muscle immediately returning to its normal position, so that the animal goes sound for a few steps, but soon after falls lame again. When the muscle becomes fixed in the abnormal position it appears tense, and its outline more distinct, whilst a depression appears in front of the trochanter.

Course and prognosis. Spontaneous recovery is never permanent; and unless operation be resorted to, habitual luxation results, *i.e.*, the lameness continually recurs, or becomes lasting. Prognosis is only grave in working animals. The accident is now less common than formerly, probably because cattle are better fed and better managed.

Treatment. When the displacement is due to stretching of the fascia, rest and good feeding favour the deposition of fat, and soon alter the conditions responsible for the accident. Counter-irritation may be employed with advantage in cases where spontaneous reduction occurs. If, however, the fascia lata is ruptured and the

trochanter firmly fixed in the fissure, operation becomes necessary to release the trochanter and restore the function of the limb. The operation may be carried out in the standing or recumbent position, the sound hind-leg being drawn well forward in order to throw weight on the affected limb. At a point about three inches below and in front of the trochanter, in the direction of the muscle, an incision about two inches in length is made through the skin and aponeurosis. The anterior border of the muscle is separated from subjacent tissues by using a spatula, a director is then passed under it transversely,

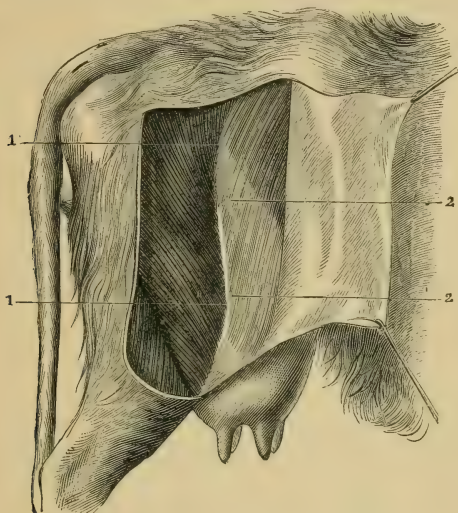


FIG. 525.—Biceps femoris muscle. 1, Anterior margin of muscle; 2, Fascia lata.

and it is divided with a scalpel from within outwards. Considerable hæmorrhage occasionally follows incision of the muscle, and the wound may have to be plugged before suturing. With proper treatment the wound heals in ten to eighteen days. Hertwig has shown that the section might be made subcutaneously.

Luxation of the long vastus is very seldom seen in the horse, though cases have been reported by Eletti and Strebel. In the horse, the muscle, when displaced, passes in front of the trochanter.

In fractures of the ischium, the tuber ischii may be displaced by the pull of this muscle, resulting in deformity of the buttock; the symptoms are similar to those in the above-described condition in cattle. Möller saw two cases of this kind,

A ten-year-old grey gelding had fallen in front of the carriage and was lame, but in the stable showed nothing unusual. A careful examination of the pelvis, proved, however, that the left buttock was abnormally flat at the height of the tuber ischii. Seen from the side, the right buttock projected considerably further than the left, the flattening, which was about 1 to 2 inches in size, was most marked over the tuber ischii, and lost itself above and below, as well as externally and internally. The right tuberosity could be distinctly felt, but the left was indistinguishable; a soft mass of muscle occupied its position, and the bone could only be felt in the depths. Around the trochanter the muscles of the quarter were slightly prominent, so that when seen from behind the left quarter appeared broader than the right. Lower down the middle line of the perineum was thrust about an inch to the left.

At a walking pace there was moderate supporting leg lameness of the left limb, which was abducted both when loaded and when freely swinging. By placing the hand on the quarter, close behind the upper trochanter, during movement, it was possible at the moment the limb was relieved of weight to detect a sensation as though a cord moved from behind forwards, and then immediately glided back again. Careful observation detected this jerking movement of the biceps femoris muscle, over a region extending from a point about 4 inches above and to the side of the upper trochanter, as far as the middle third of the femur.

The accident was probably due to old fracture of the tuber ischii, resulting in the point of insertion of the biceps femoris muscle being torn away and the muscle being displaced in a forward direction, thus differing from the condition usual in cattle, where displacement is backward.

Feyer describes a case which may have been due to displacement of the biceps femoris muscle. The horse was in heavy work. When at rest, weight was equally placed on both hind limbs, but the left limb was held a little further from the middle line of the body. On the outer side of the left thigh was a depression about 8 inches long and 2 deep, beginning in front of and below the biceps femoris muscle, and extending obliquely downwards and backwards, becoming gradually more and more shallow. Behind this, and corresponding to it in extent, was a swelling in the position occupied by the anterior edge of the semi-tendinosus muscle. The swelling seemed on palpation like a mass of tense muscle. The skin could be lifted and moved over the surface of the depression; pain and increased warmth were absent. In walking the leg was advanced with a circular sweep and set down in a position of abduction. The stride was shorter than that of the sound leg, and the leg was lifted and advanced soon after it passed the vertical position. The horse was not very lame when trotting, though the peculiar gait was more marked. As the horse was still able to do the slow work in which it had been engaged no treatment was carried out.

IX.—HIP LAMENESS.

NOT infrequently the symptoms of hind-leg lameness are so ill-defined that it is impossible to detect the exact cause, in addition to which pathological changes occur in the quarter and upper parts of the hind limb, especially around the hip-joint, the exact nature

of which evades even the most careful examination. Owing to the thickness of the muscles, thorough palpation of deep-seated structures is impracticable, and inflammatory swelling and other anatomical changes often remain undetected, leaving the cause of disease obscure. Such cases are generally included under "hip lameness." The term comprises all forms of obscure lameness, in which, however, the symptoms point to the hip region as the seat of injury. "Hip lameness," therefore, has the same position amongst lamenesses of the hind limb as "shoulder lameness" amongst those of the fore limb.

To enumerate all the diseased conditions which might produce hip lameness would be almost impossible, the causes being too varied. Only the most important can therefore be enumerated. Hip lameness may originate in the following structures:—

(1) In the hip-joint. Mechanical injuries, bruises produced by falls, collisions, or kicks, displacements in consequence of slipping, of the foot being caught in the ground, &c., are all liable to produce inflammation and lameness. Sometimes the skin and surface muscles are more affected than the joint proper, and then there is more or less pronounced inflammation over the hip-joint or external angle of the ilium.

Partial or complete rupture of the ligamentum teres and extravasation of blood into the joint are sometimes met with. In a horse which had suffered from hip lameness for more than a year, the hip-joint was found to be surrounded by fibrous connective tissue, and to exhibit periarticular osteophytes. The synovial membrane was about 2 inches in thickness, the articular cartilage had partly disappeared from the cotyloid cavity, and its edges were undergoing degenerative change. The case was therefore one of arthritis chronica sicca (coxitis chronica). Whilst making a post-mortem of a horse, the subject of hip lameness, Prietsch found fracture of the cotyloid cavity which had not been diagnosed during life.

In cattle, luxation of the femur may remain unrecognised. Harms states having seen subluxations in these animals. Noack found double-sided purulent inflammation of the hip-joint in an eight-year-old cow. The joints when opened discharged about a cupful of very thick, gruel-like, greyish-brown, offensive pus. Noack described the disease as metastatic, and considered it a result of the traumatic pericarditis which had simultaneously existed. In oxen purulent coxitis is sometimes of tuberculous origin. In the specific arthritis ("navel-ill") of young animals, purulent disease of the hip-joint may be seen. The arthritis chronica sicca, known in man as *malum coxæ senile*, is not common in horses. Both clinical observation

and the results of post-mortem examination support this view, though occasionally the disease does occur in animals. In dogs, it often causes chronic hip lameness, and it has been seen in foals.

(2) Another cause of hip lameness is disease of the bones, *i.e.*, of the lumbar vertebræ, pelvis, and femur. Old fractures of the pelvis sometimes occasion obscure lameness. In one such case Bayer detected fracture of the os pubis. On superficial examination, fracture of the external angle of the ilium may be mistaken for hip lameness, as may fracture of the trochanter of the femur. Under the title trochanteric lameness, Williams describes a disease of the upper trochanter in the horse, manifested by chronic inflammation and formation of exostoses.

(3) The cause of hip lameness is more often to be sought in the muscles than in the hip-joint and the bones. In lameness following external injuries, bruises, sprains, and partial ruptures (in consequence of falls, kicks, collisions, or over-exertion), the seat of disease is often in the muscles, especially in the superficial layers.

Particular attention should be directed to disease of the tendon and tendon bursa of the gluteus medius muscle, to thrombosis of the iliac arteries, and in cattle to displacements of the biceps femoris. In exceptional cases, this also occurs in the horse.

Kutzner, in a horse, noted gradually increasing atrophy of the biceps femoris muscle and of the upper portions of the semi-tendinosus. Lameness only appeared after three or four months, when atrophy was far advanced; the foot was adducted just before the end of the stride, and set down too far under the body. The horse showed weakness in movement, and after lying on the diseased side was unable to rise. Kutzner referred the condition to thrombosis. Roloff noted paralysis of the gluteus maximus in a heavy draught-horse. When walking the affected leg was advanced further than its neighbour, and was drawn towards the opposite side, causing the hindquarters to roll towards the sound side at every step. The animal had great difficulty in moving backwards, dragged the foot along the ground, and could scarcely advance it beyond that of the opposite side. During movement, the thigh was strongly flexed, but only partially extended. The animal showed no pain whatever. The muscle gradually became atrophied, and its place was finally occupied by a trough-shaped depression.

K. Günther describes a similar case, which he refers to paralysis of the lumbar plexus. In this case the limb was so excessively extended during movement that the hoof even touched the chest or elbow. It was, however, still capable of sustaining weight. At a later stage the muscles of the quarter showed marked atrophy.

Noack found rupture of the tensor vaginæ femoris muscle just below its insertion into the external angle of the ilium. The horse became sound in a month. Franke's case of atrophy of the muscles of the quarter in consequence of paralysis of the gluteal nerves has already been alluded to (*vide* "Paralysis of the Gluteal Nerves"),

(4) Until the typical peripheral nerve lamenesses were first recognised they also were included under the description "hip lameness." It is possible that certain cases described as hip lameness are due to functional disturbance of the sciatic, crural, or obturator nerve. As already stated, Gunther describes cases produced by paralysis of the lumbar nerves. The descriptions of neuralgia of the sciatic nerve in animals are unconvincing; certainly the occurrence of this condition has not yet been clearly proved.

(5) Finally, disease processes near the hip-joint may produce lameness, the real cause of which either remains undiscovered, or is only revealed after very careful examination. Scirrhus cord, swelling of the inguinal glands, inguinal and femoral herniæ, all interfere with movement, and sometimes produce lameness, simulating that due to disease of the hip-joint, or of the bones or muscles. Inflammation of the subcutis over the hip-joint may also result in lameness.

Symptoms. Although the various forms of hip lameness, being due to different causes, exhibit important peculiarities in their symptoms, yet, taken as a whole, they show certain features of general agreement. Thus in all there is difficulty in advancing the limb (swinging leg lameness), retardation of movement and shortening of the forward stride, and in many a tendency to stiffen the limb during movement and to drag the toe. When the hip-joint itself is diseased, there is supporting leg lameness, and the animal tries to avoid throwing weight on the affected side—symptoms which are usually absent in the purely muscular forms. Lameness is marked when turning and backing, and appears in an aggravated form after severe exertion. Sometimes it is most distinct when commencing work, and gradually decreases; sometimes the reverse. Though rheumatic lameness usually wears off with exercise, the continuance or aggravation of lameness under such circumstances by no means points to a traumatic origin. Mechanical injury is a much more frequent cause of lameness than rheumatism.

Sometimes anatomical changes, such as muscular atrophy, swelling and increased warmth, which can be detected, assist diagnosis, and render it approximately exact. The more thorough and complete the examination, the less common will be the diagnosis "hip lameness," which we are only justified in delivering when careful examination shows no visible cause elsewhere for lameness.

In other words, diagnosis must be arrived at by a process of exclusion. Cases occur, however, which even the most practised fail exactly to trace to their source.

Course and prognosis. In forecasting the termination of a case valuable indications are afforded by the character of the onset and course. Sometimes the disease appears suddenly, sometimes slowly; sometimes it disappears in a short time, sometimes continues for months; sometimes it appears altogether incurable. These variations are always important in determining diagnosis and prognosis; indeed, the prognosis often depends entirely on the course. The following principles are in general true:—

(1) Sudden lameness points to mechanical injury, and usually takes a more favourable course than that which develops slowly but progressively.

(2) When improvement has once set in, complete recovery becomes probable in direct proportion to the rapidity with which the lameness has diminished. The gradual increase of lameness indicates pathological changes, probably of an obstinate character.

(3) The older the lameness, and the more marked the anatomical changes (muscular atrophy), the graver the prognosis.

(4) Intermittency or remittency in the lameness is also an unfavourable feature, particularly if the horse has been rested and properly treated.

(5) The work to be performed must also be considered: thus riding and heavy draught horses offer less probability of permanent recovery than those in light work.

(6) Disease of the joint is far less hopeful than muscular disease.

Treatment. In recent hip lameness, accompanied by inflammatory symptoms, rest and cold applications, continuous cold-water irrigation, or ice poultices are indicated. If the symptoms suggest rheumatic disease—that is, if lameness decrease with movement, if the course be intermittent, and if the disease appear without apparent cause—warm moist packs are better, and may be followed by infriktion with mild irritants, like oil of turpentine, spirit of camphor, or ammonia liniment. The animal should be rested, and placed in a warm stall. In muscular disease, massage, in the form of rubbing, is valuable; but where paralysis is surmised, striking or beating the muscular tissue is better, and seems to check degenerative processes.

If no marked improvement occurs in eight to fourteen days, a blister of cantharides, bichloride or biniodide of mercury (1—8) may be applied. It is best to mark out with chalk, or by clipping the hair, the position in which the ointment is to be applied to the hip-joint, otherwise stablemen always apply it over the external angle of the ilium.

Should this treatment also fail, setons, subcutaneous injections of

veratrin, or the application of the actual cautery may be resorted to. The best results follow deep firing with a fine needle point at a high temperature. Graillot's cautery is very useful for this purpose. Six to eight points may be made round the joint, and, if considered necessary, a blister may be applied. Amongst other injections, a concentrated solution of common salt has lately been recommended. Its action is uncertain and difficult to control, though when the injection produces abscess formation, it certainly acts somewhat like a seton. After recovery from long-existent lameness, particularly from lameness produced mechanically, the horse should not immediately be put to work, and heavy draught should especially be avoided.

An occasional cause of hip lameness in old horses is to be found in ossification of the fascia covering the gluteal muscles. Dollar diagnosed during life and removed after death, from the gluteal region, a cribriform plate of bone measuring 10 inches long, 7 wide, and at its thickest point $\frac{1}{2}$ an inch thick. Properly speaking, this plate was double, and a space existed between the external and internal layers. Laquerrière saw and removed a plate of bone about 5 inches in length and $2\frac{1}{2}$ inches in breadth from the external crural region. The horse, which had previously been lame, was at once cured. Cadiot saw ossification of the tendon of the semi-tendinosus muscle. The bony plate was triangular; the base uppermost. It measured 6 inches in length by 3 in breadth, the point being embedded in the tendon of the semi-tendinosus muscle. (See Cadiot and Dollar's "Clinical Veterinary Medicine and Surgery.")

B. DISEASES OF THE STIFLE-JOINT.

The two divisions of the femoro-tibial joint formed by the condyles of the femur, the inter-articular fibro-cartilages and the head of the tibia, often communicate with the femoro-patellar joint, which is formed by the femoral trochlea and the patella. The synovial membrane of the external femoro-tibial joint covers the tendon of the popliteus, and invests the common tendon of the extensor pedis and flexor metatarsi muscles. In the horse, a bursa (b. prepatellaris), varying from the size of a bean to that of a walnut, is found on the upper part of the anterior surface of the patella.

I.—LUXATION AND SPRAIN OF THE FEMORO-TIBIAL JOINT.

THE femoro-tibial joint has broad articular surfaces, and a powerful ligamentous apparatus. It is surrounded by strong muscles and tendons, whilst the tibial spine projects between the condyles of the femur, and the relations of the two bones are so secured that in

animals luxation of the joint is of rare occurrence. Isolated cases have, however, been seen in cattle and dogs.

Thus Stolze describes complete luxation of the tibia forwards. The cow was unable to advance the limb, which was rigid and somewhat shortened. It was still possible, however, to place weight on the leg, and the displacement of the bone could be detected by palpation of the stifle. Reposition, though difficult, was finally effected, but luxation soon recurred, in spite of the animal being slung. After replacing the parts five times—an operation which appeared easier on each occasion—a blister was applied; the parts remained in position, and in three months the animal could move fairly well, and was able to return to grass.

Sprain of the stifle-joint may possibly occur from violent movements but is certainly not common in large animals. Possibly the chronic inflammation of the femoro-tibial joint (*gonitis chronica*) seen in dogs is due to such injuries. In cows, Sand noticed spontaneous dislocation of the tibia following partial destruction of the inter-articular cartilages, in consequence of chronic *gonitis*.

II.—DISPLACEMENT OF THE PATELLA. LUXATIO PATELLÆ.

THE patella is retained in position by a capsular ligament strengthened by two lateral ligaments, and by its straight ligaments, of which the horse and ox possess three; most other animals, however, only one. Finally, the pull of the triceps extensor cruris and tensor vaginae femoris muscles sustains the patella above. Horses, oxen, and dogs, are the commonest sufferers, and the luxation is either—

- (a) Upwards, over the internal lip of the trochlea of the femur; or
- (b) To the side, and always to the outer side, except in the dog, in which luxation is usually inwards.

The two conditions, however, differ not only in their symptoms, but also in their prognosis and treatment, and therefore will receive separate consideration.

(a) **Luxation of the patella upwards**, which occurs in oxen and horses, and has been seen by Olivers in a mule, is, strictly speaking, only an arrest of the patella within its articular capsule, the bone passing upwards over the internal lip of the trochlea and failing to return. It is fixed in this position by its lower border lying against the upper margin of the inner lip of the trochlea. This luxation can, therefore, only occur after excessive extension of the stifle-joint. Violet advanced the theory that the patella is retained on the trochlea of the femur by its internal ligament. The surface of the internal lip of the trochlea describes the segment of a circle around the point of insertion of the internal lateral ligament into the femur. It can, therefore, easily be imagined that under certain circumstances the

upper portions of the articular surface may lie nearer to the point of insertion of the ligament than the portions below. As a consequence the patella might easily become fixed in position on that surface of the inner trochlear lip, which Violet describes as being concave in the horse, and which in oxen is level, and require considerable exertion of strength to draw it down. Solleysel, Lafosse, Meyer, and many others have attributed the fixation of the patella to cramp, spasm, or tonic contraction of the patellar muscles, including the long vastus. Whatever the explanation may be, there is no doubt that the patella is sometimes arrested for a few moments, and under certain circumstances, for a longer time at the highest point in its course, and the action of the limb interfered with. The condition may be regarded as fixation of the patella in a position of excessive extension. It has also been termed subluxation or arrest of the patella.

Causes and symptoms. Upward luxation or arrest of the patella may be due to one of two causes:—(1) flattening of the surface of the inner trochlear lip in conjunction with abnormal tension in the lateral ligaments; or (2), fixation of the lower surface of the patella on the upper border of the inner trochlear lip.

In the first case the lameness is often recurrent, but only lasts for a few moments on each occasion (habitual luxation). This may, therefore, be termed momentary upward luxation of the patella; and that produced by fixation of the lower border of the patella on the upper border of the internal lip of the trochlea, stationary upward luxation. Movement of all the joints of the limb, with the exception of the hip-joint, is dependent, however, on movement of the stifle, and therefore when the stifle is fixed the other joints are at once immobilised in an extended position, and flexion and free movement are lost (see Fig. 529, and “Rupture of the Flexor Metatarsi Muscle”). In fact, any interference with the movement of the patella produces lameness: in the case of momentary luxation there is a slight check, similar to that seen in stringhalt, just as the foot leaves the ground and should begin its stride. Bassi, indeed, regards stringhalt as due to momentary luxation. The peculiar check known as “straw cramp” is often seen in the stable when the animal turns round, sometimes in one, but not infrequently in both limbs. As a rule, it gradually disappears during work, sometimes only occurring during the first twenty to thirty steps. The sudden flexion of the limb which follows the check has produced the erroneous impression that it is due to cramp in the vasti and rectus muscles. It is not uncommon after influenza and other debilitating diseases.

The degree of lameness varies greatly. Sometimes it is necessary to look carefully in order to recognise it at all, but in other cases the patella is seen to remain fast for a moment and then suddenly descend.

The symptoms are different when the patella remains continuously fixed above the internal lip of the trochlea, *i.e.*, in stationary upward luxation. Loose-jointed, weak foals with straight stifles are oftener affected than well-developed horses. In consequence of violent contraction of the vasti and rectus muscles occurring when rising or falling, kicking outwards, or extending the limb, the patella passes too far upwards, and becomes fixed. Fixation of the patella on the upper portion of the internal lip of the trochlea is at once followed by extension of all the joints of the limb and inability to flex them, even with external assistance. The limb is therefore directed backwards, and cannot be advanced. If the animal is made to advance, the fetlock alone is slightly flexed, and the toe, directed backwards, is trailed on the ground. If both limbs are affected at the same time, the animal stands as though rooted to the spot and cannot advance; when only one limb is affected, it can still hop forwards on the other leg. Locally, very little deformity can be seen at the stifle which is fully extended. By palpation, the straight patellar ligaments are found very tense, and the internal trochlear lip and patella are in close contact and immovable. If, whilst the patella occupies this position, the rectus and vasti muscles be relaxed, the patella may slip from the lip of the trochlea of the femur and stand upright on its lower border, a condition which in man is known as vertical luxation of the patella. The symptoms are so characteristic that stationary luxation can be diagnosed from a distance, and is only likely to be mistaken for dislocation of the biceps femoris muscle in oxen, in which, however, the extended position is not so well marked, and the limb can always be flexed, if only to a slight extent, while the trochanter may be felt under the skin, and the patella at least moved sideways. In luxation, on the other hand, it is absolutely immovable, and lies too high.

In some instances probably the straight ligaments of the patella have become elongated, as happens in pregnant animals by continual confinement to the stable, or in others while passing through severe attacks of debilitating diseases like influenza, strangles, and pneumonia. Not infrequently such elongation is congenital.

The prognosis is generally favourable. In weakly foals, and in animals attacked during convalescence, both momentary and per-

sistent luxation usually cease to occur as the general condition improves.

Treatment. Young animals and convalescents should be well fed and kept from heavy work. With rest and the recumbent position, the straight ligaments of the patella return to their normal length. Everything likely to cause relapse must be avoided. In momentary luxation nothing further, except blistering the stifle, can usually be done, but stationary luxation calls for immediate reduction, which may be effected in one of several ways.

(1) The patella often returns to its proper position after sudden backward or side movements. Energetic contraction in the patellar muscles, produced by an unexpected blow or by drenching the animal with cold water, also induces reduction at times.

(2) Where the above means prove insufficient, an attempt should be made to free the lower edge of the patella by pressing on its upper and outer border, the pressure being directed backwards and inwards.

Meyer advised grasping the patella with the hand and lifting it up whilst the animal was led forwards.

Reduction is assisted by passing a cord round the fetlock, lifting the toe from the ground, and drawing it forward, thus forcing extension of the stifle-joint. The animal is then thrust backward, and at the same moment the patella pushed back. Where the animal is lying, the limb can be drawn forward and fastened as for castration, replacement being attempted in this position. In order to induce muscular relaxation chloroform should be administered.

After successful reduction, the animal may be rested for a few days; in exceptional cases a longer rest may be prescribed. The application of blisters, etc., to the stifle is only useful in keeping the limb at rest. If the patella again slips upwards when the animal lies down or rises, slinging may be resorted to, the affected limb being prevented from moving backward by a sideline attached to the pastern and secured round the neck; or a shoe with a toe-prong may be applied. Another useful device for recurrent luxation is a patten shoe with deep staple, by which the limb is raised from the ground, and the stifle-joint is kept semi-flexed, so that the conditions necessary to upward luxation cannot well occur.

Bassi and others recommended section of the inner straight patellar ligament, and state having cured cases of repeated upward luxation which had existed for years. The operation is, however, by no means free from risk, because the inner straight ligament is in close proximity to the capsule of the joint, but by dividing the ligament near to its insertion on the tibia, where an abundant fatty

tissue separates the synovial membrane from the ligament, there is little danger of opening the articulation. The operation is followed by immediate relief, the patella resuming its normal position on the trochlea. Bassi, Cadiot, and others have operated successfully on horses, but Morey failed, luxation at once recurred, though it was more easily reduced than before operation. Cavallari performed the operation with immediate and lasting benefit on both stifles of a cow, and Savio was equally successful with four cases in cattle. Probably failure of the operation in horses is sometimes due to persistent abnormal contraction or shortening of the triceps, which by carrying the patella upwards, tends constantly to reproduce luxation, even when both the internal and middle straight ligaments have been divided and reduction has been temporarily effected (Cadéac). To counteract this muscular contraction, repeated daily massage of the extensor muscles, after reduction of the luxation, has been recommended.

B. Lateral luxation of the patella.

In horses and cattle, the patella may be displaced laterally, and almost always towards the outer side. In dogs, inward luxation is the rule, and the condition may be congenital and bilateral, and due to abnormal conformation of the internal lip of the femoral trochlea.

Acquired outward luxations are dependent on rupture or excessive strain of the inner lateral patellar ligament. As the inner lip of the femoral trochlea is much larger than the outer lip, inward luxation is extremely rare in horses and cattle, though Stockfleth saw one case in a cow. In outward luxation the patella may rest to some extent over the external lip (incomplete luxation), though it is generally thrust on to its outer surface (complete luxation). Meyer saw luxation of this kind in two cows.

Causes. The predisposing causes of lateral luxation are uprightness of the limb, obliquity of the quarters, and youth of the animal. The condition may appear in both limbs. Another factor may consist in relaxation and weakness of the ligaments. In dogs the outer lateral ligament is much slighter than the inner.

Everything favouring rupture or strain of the internal lateral ligaments may produce the condition. Meyer believed it was caused by rheumatic contraction in or excessive action of the abductors, but failed to effect a cure by dividing them.

The prognosis is less favourable than in upward luxation, particularly in dogs. Pugs often suffer congenitally, and little can be done for them. As in other cases, the older the luxation the greater

the difficulty in reduction and retention, and the less the chance of recovery. Incomplete outward luxation is clearly more favourable than the complete form. Meyer's cases recovered sufficiently to allow the animals to be used for milking purposes.

Symptoms. The clinical symptoms of complete dislocation resemble those of crural paralysis or rupture of the extensors of the stifle-joint. They consist of lameness when weight is placed on the limb, with excessive flexion of all the joints. Where the patella is displaced outwardly, the function of the rectus and vasti, and consequently the ability to bear weight, are lost, though the muscles named can still carry the limb forward. At rest, the affected leg is advanced beneath the belly, and in movement the limb is carried or only touches the ground. The altered position of the patella produces marked prominence of the outer surface of the stifle, and effaces the depression which normally exists in front of the joint. The patella can be seen and felt in its abnormal position, and it can be moved from side to side, when the limb is held forward. In dogs the patella is readily replaced, giving immediate relief from lameness, but soon slips out again (habitual luxation). In horses reduction is more difficult.

Treatment. As already stated, replacement proves easy in the carnivora, but in all animals retention is difficult. Hertwig states having kept the patella in position by hand for forty-eight hours. Relays of assistants were employed, and a blister was afterwards applied. As bandages cannot be used to retain the parts, treatment is generally confined to rest and blistering, which compels the animal to keep the foot as still as possible. Large animals should be placed in slings. Recurrent luxation in the dog can be cured by section of the common tendon of the patellar muscles. Luxation having been reduced, the patella is held on the trochlea while the tendon is subcutaneously divided close to its insertion on the bone. Aseptic precautions must be observed.

Möller saw a peculiar displacement of the patella upwards and outwards. It was impossible to bend the limb, which was directed forwards, but weight could very well be borne on it. When forced to move, the animal carried the leg forward, holding it stiffly, and not moving the hip, stifle, or hock joints, and placed it far in advance. The progress of the body then brought the limb perpendicularly under the hip-joint, but the leg could not be placed behind this point, either actively or passively. Slight pressure against the outer edge of the patella sufficed to return it to its position, after which the horse could sometimes walk for several steps in the usual way; suddenly, however, the patella again became displaced, and all the symptoms returned.

The post-mortem showed the inner lateral and inner and middle straight

ligaments to be diseased and elongated, allowing the lower border of the patella to ride up over the outer lip of the trochlea, and become fixed there. The upper border of the patella inclined forwards (vertical luxation), and the bone itself slipped outwards to an extent of nearly 1 inch over the external condyle of the femur. When the patella was replaced, the ligaments named were seen to be distinctly relaxed. The continual pressure exercised by the lower border of the patella had caused absorption of the articular cartilage of the femur, and the formation in it of a distinct depression, corresponding in shape to the lower surface of the patella. Attempts were made during life to fix the bone in its proper position by a dressing, and for a time proved successful, but had to be given up in consequence of their causing inflammation and necrosis. The most effective appliance was a broad strap fixed to the slings, and buckled round both stifle-joints.

A splint was so applied to the tibia as to exercise pressure on the outer surface of the patella, but was only partially successful, though, after eight days of this treatment, the patella remained in position, and the animal could stand and even walk some steps without assistance. Previously it had been unable to make even a single step without the patella becoming displaced. Unfortunately it died from intercurrent disease.

Dollar saw a somewhat similar case which is described and illustrated in "Clinical Veterinary Medicine and Surgery," p. 439.

III.—RUPTURE OF THE STRAIGHT LIGAMENTS OF THE PATELLA.

MÖLLER describes two cases of rupture of the outer straight ligament in horses, the first case caused by the impact of a carriage-pole, the second probably by suddenly springing up in the stable. Both animals showed marked supporting leg lameness. At first no weight at all was thrown on the affected limb, and later, only a certain amount. The internal and middle straight ligaments could be felt below the patella, but the place of the lateral one was occupied by a depression. There was great pain on pressure below the patella, which, however, preserved its natural position. Treatment consisted in absolute rest: one patient was sufficiently improved in three weeks, the other in a month, to allow of their leaving hospital.

Voigtländer saw rupture of the straight ligaments in an ox. The symptoms were: inability to stand, severe inflammation around the stifle-joint, flexion of the limb, inability to extend the stifle, and relaxation of the straight ligaments. The animal was slaughtered, and the rupture confirmed by post-mortem.

IV.—FRACTURE OF THE PATELLA.

FRACTURE of the patella is rare, and up to the present has only been seen in horses. Kicks, collisions, and falls with the stifle-joint strongly flexed are the principal causes. Wollstein reports a case produced by struggling in hobbles, whilst Renault saw double-sided

fracture in a horse in slings; the sling had worked backwards until the horse's hind feet were no longer in contact with the ground. Another animal is said to have broken both patellæ by slipping.

Fractures due to external violence are often comminuted, and associated with injury to the joint. Horizontal fractures are usually the result of violent muscular contraction. Vertical fractures are occasionally seen after mechanical injuries. There is then rarely any displacement, as the fibrous tissue covering the anterior surface of the bone retains the fragments in contact.

Symptoms and course. Fracture of the patella is characterised by severe lameness, inability to bear weight on the limb, violent pain on movement and pressure, and swelling in the stifle region. Provided swelling is not too great, the pieces of bone can sometimes be felt, though there is rarely crepitation. The **prognosis** is in most cases unfavourable. In men, although much more can be done than in horses, ligamentous union is the rule, because the fragments are considerably separated, and on account of its want of periosteum, the bone is little fitted for callus formation, while its lower portion is deprived of blood-supply, which for the most part is derived from the muscles. More successful results have been obtained in late years, since it has been found possible to reunite the fragments by means of ivory pegs, stout silver wire, or steel screws silvered on the surface. In the early days of antiseptic surgery such methods were thought impracticable, but it has since been found that foreign bodies, like screws, &c., if sterilised before insertion, do not necessarily cause suppuration. Transverse fractures and fractures into the joint are in large animals unfavourable; the good results reported are in most cases due to errors in diagnosis. Andrieu, however, describes one case where the patella was split into three portions and the patella-joint opened, as evidenced by the escape of synovia. By introducing the finger through a wound on the front of the patella the fractured bone could be felt. The parts were subjected to continuous irrigation. In a fortnight the animal could walk slowly; in a month it did very light work; a month later it showed only slight lameness when trotting. Such a case is quite exceptional. When, however, only a small piece, like the point of insertion of one of the straight ligaments, is torn off, recovery may occur in a month.

Treatment must follow general principles. Large animals require slinging, and in small ones a dressing should be applied, the limb being as much as possible extended.

V.—INJURIES AND INFLAMMATION OF THE STIFLE-JOINT. ACUTE GONITIS.

THE larger domesticated animals, and horses in particular, often suffer injuries of the patella and stifle from barbed wire, kicks, stabs with stable-forks, thrusts with lances, sabre cuts, &c., which give rise to suppuration in the joint (*Arthritis purulenta*). Inflammation may also extend to the joint from the tendon sheath of the flexor metatarsi and extensor pedis; and as both portions of the femoro-tibial joint communicate, suppuration extends from one to the other, and eventually to the patellar joint.

The synovial membranes are congested, swollen, much thickened, and their internal surface is covered with soft, reddish-grey granulations. The articular surfaces are dull, greyish-blue, rough, atrophied and softened; deep erosions may be absent. The joint contains a quantity of a viscid, purulent fluid.

The symptoms are: severe lameness; the animal carefully avoids placing weight on or moving the limb; all the joints of the limb are held stiffly in a position of flexion (Fig. 526); there is diffuse painful swelling of the joint, which discharges a purulent synovia. The animal shows fever and loss of appetite, lies continuously, if not placed in slings, and may die from exhaustion with symptoms of septicæmia.

Acute aseptic or serous inflammation of the stifle-joint is less frequent, but it may be symptomatic of rheumatism, or it may follow violent bruising or wrenching of the stifle, and lead to extravasation into the joint or to chronic serous arthritis (dropsy of the stifle). Acute closed arthritis is distinguished by lameness, intense local pain, and the presence of a fluctuating swelling over the stifle. Under treatment the acute symptoms may gradually subside, or the disease assumes a chronic course, the stifle remaining enlarged and the horse more or less lame. Cadiot described a case of tuberculous gonitis in the dog. In oxen, less frequently in horses, rheumatic inflammation of the stifle-joint has been seen.

Chronic serous arthritis, or dropsy of the stifle-joint, may result from the acute form, or it may develop very early in life. It may affect one or both stifles, and is sometimes attributed to hereditary weakness of the joints. The stifle is disfigured by a painless swelling, which hinders movement, but otherwise does not appear to cause inconvenience.

The prognosis of suppurative gonitis is almost hopeless, and in most cases slaughter is to be advised. Fat oxen should at once

be killed, to avoid the loss of condition which results when disease becomes general. The acute aseptic or closed form may be treated, particularly in valuable animals. The prognosis should be reserved if severe pain exist, because the continuous weight thrown on the other foot may produce acute laminitis, or the animal, unable to stand, may die from exhaustion. Severe complications, nevertheless, may render even this form incurable; thus, a horse which had been struck by a carriage-pole suddenly became lame; the animal died, apparently in consequence of pain, and on post-mortem, two fragments of bone as large as chestnuts were found to have been detached from the outer condyle of the femur; they lay within the joint capsule. On the other hand, a seemingly severe injury exposing the patella healed in a month. In this case the joint was probably uninjured. Sherman saw a horse die from division of the femoral artery produced by a lance-thrust in the flank.

Treatment. Recent wounds near the joint, or involving the above-named tendon sheath, require antiseptic treatment; and, as in large animals a proper dressing cannot be used, the wound must be disinfected, and in the case of small injuries a blister of sublimate dissolved in 10 parts of spirit, or the actual cautery should be applied, in order to produce swelling, and close the wound in the joint as rapidly as possible. Large wounds may be carefully disinfected and sutured, or be kept aseptic by continuous irrigation.

Acute serous arthritis may be successfully treated by rest, and warm fomentations, and, after an interval, by applications of iodine, oleate of mercury, or cantharides collodion. Treatment of the chronic or dropsical form often fails. Firing and blistering may reduce the swelling, but the joint is permanently blemished. Complete recovery has followed aseptic puncture of the capsule, by means of a fine trocar or hollow needle, drawing off the contents, and afterwards firing and blistering the joint. Aseptic removal of the fluid, with injection of iodine or weak sublimate, may be tried. Usually the joint refills, but later shows a considerable diminution in the swelling. Operative puncture of the stifle is never quite free from risk of infection, and unless the horse can be kept in slings for a time and carefully attended, puncture is not advisable. Sometimes in young horses the distension disappears without treatment of any sort.

VI.—CHRONIC INFLAMMATION OF THE STIFLE-JOINT.

CHRONIC inflammation of the stifle-joint usually involves the femoral condyles, inter-articular fibro-cartilages, and tibial facets, and principally occurs in heavy draught horses. Occasionally, and generally in horses that work continuously at a sharp trot, the disease affects the femoro-patellar articular surfaces. Chronic gonitis of the femoro-tibial joints is also seen in dogs, particularly in the larger coursing and working breeds. In dogs, the disease is generally unilateral; in horses it sometimes affects both stifles. Höhne regards it as a common cause of lameness in horses, and thinks it is often mistaken for developing spavin, but the symptoms differ considerably, and should not be confused if care be taken in diagnosis. In femoro-tibial disease post-mortem examination discovers changes similar to those of arthritis chronica sicca vel deformans: erosions or excavations of the condyles and tibial facets, with more or less destruction of the inter-articular fibro-cartilages and thickening of the synovial membranes. Erosion of the articular surfaces is most marked around the tibial spine and at the inferior surface of the condyles; osteophytes occur, and there is sometimes moderate dropsy of the joint. As a rule, the inner division of the joint undergoes more destruction than the outer, which sometimes remains intact or little altered.

In femoro-patellar disease similar changes occur in the articular surfaces. In addition to thickening of the intra-articular ligaments and cauliflower growths on the articular surface of the femur, Höhne found eburnated elevations and depressions in the spongy tissue of the ends of the bones, and enlargement of the inner condyle to the extent of three-eighths of an inch. Sometimes he could only detect condensation of the spongy tissue of the inner condyle. It is, therefore, not absolutely certain that Höhne was always dealing with the disease now in question.

Symptoms and course. Femoro-tibial disease develops slowly and very gradually, but eventually proves so troublesome that the animal has to be destroyed. Sometimes it persists for months, or even years. At the outset, the lameness is slight or intermittent, and where the disease is bilateral may for a long time be overlooked. In the stable at first, the diseased limb is knuckled at the fetlock; when both limbs are affected, they are rested alternately; later, the limb is semi-flexed and the foot is held raised from the ground (Fig. 526). In turning, the affected limb may be lifted spasmodically, as in spavin and stringhalt. When commencing to walk,

the animal shows swinging leg lameness and avoids extending the limb, so that the forward stride is shortened. The toe of the diseased foot is apt to catch on slight prominences; at a trot the lameness shows some resemblance to spavin lameness, but the limb is not moved spasmodically, much more often it is carried stiffly.

Though pain cannot usually be detected, the capsule of the joint is often visibly distended below the patella, and in the later stages the internal condyle of the femur is distinctly increased in size. This

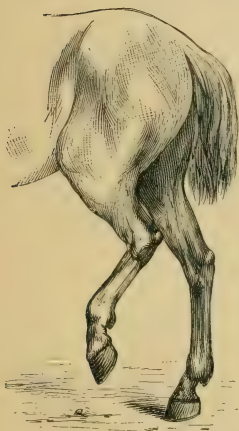


FIG. 526.—Left-sided chronic inflammation of the stifle-joint (*Gonitis chronica*).



FIG. 527.—Bilateral chronic inflammation of the stifle-joint (*Gonitis chronica bilateralis*) (from a photograph).

examination is made standing behind the horse (of course taking proper precautions) and grasping the stifle-joints alternately with both hands, so as to compare one with the other. In femoro-patellar disease the leg is extended, bearing weight, and in movement the limb is abducted and the toe dragged. The animal shows symptoms of pain when the limb is forcibly extended or rotated, and there is considerable swelling in front of the stifle.

The disease is incurable, and neurectomy being out of the question, nothing can usually be done. Working-horses should be used as long as possible. If the owner insists on treatment, blisters, firing,

or other counter-irritants can be tried. Recovery is extremely rare, and the improvement of reported cases probably depends on mistakes in diagnosis.

A twelve-year-old gelding in heavy draught had for two years shown slight lameness in each hind limb alternately. The limbs gradually became upright, the movement stiffer, and the quarters more markedly sloping. In both limbs, the capsular ligament of the stifle-joint was prominent, being best defined below the patella (Fig. 527). When resting, the hind legs were lifted alternately and strongly flexed at short intervals; the horse had not lain down for a long time. In work, the hind limbs were carried stiffly and the stride shortened. The animal had become so useless that its owner caused it to be slaughtered.

The post-mortem examination showed marked proliferation of connective tissue in the muscles of the quarter and thigh, the new growth appearing in the perimysium externum in the form of broad white bands (myositis chronica fibrosa). There was chronic inflammation in the gluteus medius bursa, with great increase in the villi, which were 1 to $1\frac{1}{4}$ inch in length and $\frac{1}{8}$ to $\frac{1}{4}$ of an inch thick.

The patellar joint was full of a yellow viscous fluid. The capsular ligament was distended, and the synovial membrane covered with long villous growths. In the true stifle-joint the articular cartilage had almost disappeared from the internal division, and scarcely a trace remained on the spine of the tibia, though numerous eburnated porcellaneous deposits were visible. The margins of the internal division of the joint, particularly the tibial margin, were prominent and thickened. The patellar joint exhibited no particular change.

VII.—BURSITIS PRÆPATELLARIS.

THE bursa præpatellaris according to Eichbaum, occurs in fully half of all horses. It lies on the anterior surface of the patella, and when injured is apt to become inflamed; the swelling, which is sometimes fluctuating, sometimes moderately firm, attaining the size of two fists. It seldom produces pain or lameness, and only forms a blemish like "capped elbow."

The disease being caused by bruises or other injuries, is sometimes accompanied by inflammatory symptoms, but sometimes occurs without them. Lameness is absent in the latter case, a fact to be remembered in diagnosing other diseased conditions. Should treatment be considered necessary, fluctuating swellings (hygromata of the bursa) may repeatedly be punctured with the hollow needle, or with a slender trocar, and emptied. Injection of iodine may also be tried. As in "capped elbow," free incision leads to long-continued suppuration, and is therefore not advisable, unless the bursa can be destroyed by cautery or caustic. Blisters and firing may produce gradual contraction, but require repeated application. Care must

be taken not to incise a dropsical stifle-joint in mistake for enlargement of the prepatellar bursa. The hydrops swelling lies deeper and cannot be so easily displaced under the skin as that now in question.

C. DISEASES OF THE LOWER THIGH OR LEG.

The thigh, especially in the horse, is surrounded by a tense, stretched skin, which on the external face is strong, but on the internal somewhat thin. Towards the front or the internal surface of the thigh, the skin and fascia of the leg lie directly in contact with the tibia, which, therefore, at this point is particularly exposed to injury. About three-quarters of the bone, *i.e.*, the entire external and the posterior portion of the internal surfaces, are covered with muscles which are singly clothed with aponeurosis and protected by the fascia lata. The latter arises from the muscles of the quarter and upper parts of the thigh, and is partly inserted into the crest of the tibia, partly extends below the hock, to become continuous with the aponeurosis of the metatarsus and pastern.

I.—WOUNDS AND INJURIES.

INJURIES of the tibia are commonest in horses, and are caused by kicks, and by the leg being passed over bales or over the carriage-pole. Sometimes the skin alone is inflamed or lacerated, but not infrequently the periosteum and even the bone are bruised. The bone is sometimes fissured by kicks, a condition which will later receive attention; or diffuse periostitis is caused, though it also follows bruising of the fascia, without the bone itself being injured.

Tibial periostitis produces well-marked swinging-leg lameness and shortening of the forward stride, while the thigh is moved slowly and stiffly. It usually lasts three to four weeks, and is succeeded by thickening over the tibia. The local pain shown on palpation prevents any mistake in diagnosis. Injuries of the tibia itself can usually be detected by probing.

The presence of strong fascia covering the muscles of this region causes wounds, which would otherwise heal without trouble, to be followed by very dangerous consequences. Injury to the fascia is troublesome, because the muscular tissue protrudes through the rent (muscular hernia), and being irritated by its edges, commences to proliferate actively;—or suppuration may extend beneath and lead to necrosis of fascia, and before the necrotic portions can be shed, excessive fungous granulations, the growth of which is favoured by the continuous movement of the muscle, arise and greatly impede healing. This condition is commonest on the lower portions of the biceps femoris muscle, but may occur in any region of the tibia.

A second difficulty in the healing of such wounds is the development of subfascial cellulitis. It generally accompanies perforating wounds caused by stable-forks. The symptoms are great pain when the animal stands on the limb or attempts to move it, moderate swelling, inflammation of the neighbouring lymph vessels and glands, and fever. The skin is not excessively swollen, but at a later stage infection extends and deep-seated abscesses break through the fascia, becoming subcutaneous. The cellulitis may lead to extensive necrosis and fatal septicæmia, a result favoured by the pent-up discharges not readily escaping through the fascia.

The treatment must be directed by general principles. Cold applications are useful in relieving severe pain; if merely bruised, the parts may be surrounded with cotton-wool, and kept continuously irrigated. Wounds, especially those reaching to the bone, are best treated by antiseptic measures. The periostitis may afterwards be arrested by blisters. Sequestra must be removed as soon as they appear to have separated. If only the skin is bruised or excoriated, the parts should be cleansed, and dusted with iodoform, amyloform, or boric acid, or smeared with lead or zinc ointment.

The exuberant granulations produced by muscular herniæ are removed with scissors, the cautery, or caustics. To prevent their return, it is often necessary to still further divide the fascia; sometimes a piece of it may be excised, and further strangulation thus prevented. Though a pressure dressing is difficult to apply at this point, benefit sometimes follows the use of a few strips of adhesive plaster. A piece of leather or strong linen is smeared with resin plaster (composed of two-thirds resin and one-third wax), and applied over a pad of gauze covering both the exuberant granulations and neighbouring parts. Absolute rest is indispensable. Subfascial suppurating cellulitis calls for early incision and disinfection, and if necessary, drainage. Deep-seated abscesses are to be opened as soon as diagnosed.

II.—FRACTURE OF THE TIBIA.

In the horse, fractures of the tibia rank next in point of frequency to those of the pelvis. Of 1,082 fractures occurring during four years amongst army horses, 189 were in this bone. Such fracture is oftenest caused by kicks from horses in neighbouring stalls, the point struck being the internal face of the lower fourth of the tibia, which lies directly under the skin. In most cases the bone is at first only fissured, and the true fracture occurs later, during such

acts as rising, lying down, or passing urine or fæces. It is seldom postponed more than a week or ten days from the date of original injury, though cases exist where fracture has not occurred until four or five weeks afterwards. In a case of Möller's, fracture was delayed until a month after the injury, and in an army horse 127 days passed after the primary accident before the parts became separated. In such cases the fracture is probably subfascial, a view supported by the commonly-observed fact that the fragments show no callus formation. Or, again, the primary injury may produce local fissuring or partial fracture which weakens the tibia, but only gives rise to complete fracture under severe strains, like those occurring when rising, lying down, &c. Abrasion of the edges of fragments either results after fracture is complete or is due to subperiosteal fracture, in which slight movement of the fractured portions is possible. The absence of abrasion is not, however, evidence that limited fracture may not have existed for some considerable time, a fact of much forensic importance. A kick on the inner surface of the tibia, such as would be given by a horse standing alongside, may at once produce complete fracture, which is then generally complicated. The bone is occasionally broken by the animal slipping, falling, being struck with the carriage-pole during collisions, or by its struggling violently in hobbles, as, for example, during castration, though, in the latter case, the femur or vertebral column is more often fractured.

With the exception of the horse, the commonest sufferers from fracture of the tibia are dogs, in which the accident is due to being kicked, run over, &c. Oxen and other animals are much less frequently affected; nevertheless, cases are seen in them, and the practitioner is even occasionally called on to treat parrots and canaries. Fenimore describes a case of fracture of the tibia in a fœtus; the fracture had actually been produced by a kick received by the mother (a cow) whilst pregnant, and when the calf was born the fracture was united.

The symptoms vary according to the degree of the fracture. Complete fracture renders it impossible to place weight on the limb, the unusual mobility of which can be detected even from a distance; the foot, when lifted, remains dangling, and in the horse the condition shows some resemblance to rupture of the flexor metatarsi muscle. Fracture of the tibia, however, is at once differentiated by the impossibility of placing weight on the limb.

In complete fracture, crepitation can always be detected. Not infrequently the exact point of fracture is discoverable, especially if low in the leg. Perforation of the skin by splinters of bone removes

the last doubts of fracture ; in such case traces of the external injury are generally apparent.

Fissuring sometimes, though not invariably, produces lameness, both when weight is placed on the limb and when it is carried. Starting from the injured point, which may be depressed, the line of fissure in the bone may be mapped out by the existence of pain over it. Fissures in the subcutaneous regions of the tibia may sometimes be diagnosed with certainty, otherwise they can only be guessed at, for this linear distribution of pain, which is the sole reliable symptom, cannot be detected under the muscular tissue. In the cases described in which there was no lameness, the fissure was probably subperiosteal. Incomplete fractures and local injuries are accompanied by more or less lameness, depending on the degree of periostitis ; should the latter be slight, lameness is so little marked that animals, even with incomplete fracture, may be kept at work until complete fracture suddenly occurs. On the other hand, partial fracture and local injury to the bone may often be at once recognised provided the soft parts are not greatly swollen. From the uncertainty which surrounds these cases, it is of the utmost importance, in every painful lameness resulting from mechanical injury to the inner surface of the tibia, to bear in mind the possibility of fissure or incomplete fracture. Its existence is the more probable if lameness be severe, and no marked periostitis or local pain can be discovered.

Fractures of the malleoli of the lower end of the tibia, common in man, are rare in animals, though on post-mortem examination Leisering detected a case which had caused obstinate and incurable lameness. The external malleolus was separated for a length of 1·4 inch, and to a height of ·6 inch. The anterior portion of the middle protuberance was fractured.

Course and prognosis. Although, in the horse, complete fracture of the tibia is almost always incurable, because the patient is unable continuously to stand on the other leg until the fracture unites, and splints, &c., can only be applied to the lower portions, yet in oxen recovery has been repeatedly seen. Recovery has also been seen in young foals ; in some cases a splint was applied, but in others no precaution was adopted. Rivolta describes a case in the ox in which a splint was applied by the local blacksmith. After six to seven weeks the animal walked sound. When the horse is valuable, and not of an excitable disposition, treatment may be attempted, especially if the seat of fracture be near the lower end of the tibia ; in such cases recovery is possible. Foals and light-bred horses of quiet temperament are better able to endure the continuous lying

than heavy animals, and therefore recover sooner. Montaya saw a transverse fracture of the upper third of the tibia in a mule unite, with the assistance of a splint. In France a number of cases are reported where complete fracture of the tibia with displacement in horses has been reduced and the bone has united. But these have been collected from the records of many years, and must be regarded as exceptional.

In sheep, goats, and carnivora, these fractures generally unite if not so high in the limb as to prevent a proper dressing being applied. In dogs, fractures of the tibia may completely unite in three to four weeks, even when complicated.

In all animals, fissures unite in fourteen days to a month, provided the fracture remain incomplete. The animals require to be absolutely rested in slings for three or four weeks. The less the lameness, the better the chance of recovery. Fractures of the malleoli are unfavourable, especially in working-horses; and as lameness is generally severe, the continuous weight thrown on the other foot may lead to laminitis.

When instituting **treatment**, the above-mentioned possibility of fracture must always be kept in mind, and every injury of the inner surface of the tibia, whether extending to the bone, or causing severe lameness, should be followed by three to four weeks' complete rest, the animal being placed in slings, or tied up short. Severe lameness consequent on periostitis is best treated with cold applications, followed by blisters. Further treatment must be expectant.

Cases of complete fracture should be placed as soon as possible in slings, reposition attempted, and a plaster-of-Paris, tripolith, or adhesive plaster bandage applied. Adhesive plaster has the advantage of not slipping down so easily. Stolz recommends a mixture of 2 parts resin with 1 part wax; Frickers, 5 parts gutta percha, 2 parts lard, and $1\frac{1}{4}$ part wax. These mixtures are smeared on strong linen or leather, which is applied after the skin has been cleansed and dried. Leblanc, who successfully treated several cases, placed the animal in slings, dug a shallow pit below the affected limb, to which he attached a heavy weight. (After a time the muscles become fatigued and reposition can be effected.) Leblanc, after setting the limb, applied masses of tow and two large splints, the outer extending from the hoof to the stifle, the inner from the hoof to the middle of the thigh. The whole limb was then enveloped in bandages plastered with pitch. In oxen, with fracture of the lower part of the tibia, a plaster bandage may be used. These animals sometimes recover without treatment of any kind.

The application of plaster or tripolith bandages is easier in small ruminants and carnivora, but to be efficacious the dressing should be carried below the hock, and as far upwards as possible ; by including the stifle-joint the security of the dressing is greatly increased, and the use of the " saddle " rendered unnecessary, otherwise it can scarcely be dispensed with. It is formed by passing the bandage over the back, and around the opposite limb. (See treatment of fractured humerus.)

When applying the bandage particular attention should be given to the position of the limb, to prevent the fragments uniting in faulty relation to one another. If union occurs with the parts rotated, movement is greatly interfered with. Before applying dressings to a complicated fracture, the wound should be carefully disinfected and covered with a layer of sterilised wadding. In case the parts cannot be rendered aseptic, a window may be left in the plaster bandage, to allow the wound to be inspected and kept relatively aseptic.

III.—RUPTURE OF THE TIBIO-FIBULAR INTEROSSEOUS LIGAMENT.

In animals fractures of the fibula have rarely been recorded ; they are certainly very difficult to detect during life. In dogs, however, the fibula is usually involved in cases of fracture of the tibia. Behnke, in a mare, saw rupture of the interosseous ligament, with separation of the fibula from the tibia, from the animal shying whilst being ridden. Severe lameness at once followed, and though it gradually diminished, it recurred after lying down and rising. The limb was carried stiffly, and no weight was placed on it. Post-mortem examination showed the fibula to have been torn away from the tibia ; it lay amongst the muscles of the thigh, which it had severely injured.

IV.—RUPTURE OF THE TENDINOUS FLEXOR METATARSI.

In the horse the tendinous portion of the flexor metatarsi muscle forms an inextensible cord, which unites the stifle and hock joints in such a way that movement of one joint produces movement of the other, and permits the muscles of the quarter and thigh to assist in extension of the hock-joint. The tendon arises from the pit between the trochlea and the external condyle of the femur, in common with the extensor pedis, passes over the stifle-joint, lying in front of the tibia, at the upper end of which it is surrounded by a mucous bursa, and is inserted by three slips into the hock and metatarsus. In ruminants the muscle is also provided with much tendinous tissue, but arises from the tibia. In carnivora it is replaced by a tendon which starts from the internal surface of the tibia

and is inserted into the bones of the tarsus, serving to prevent excessive extension of the hock-joint.

In the horse, rupture of this tendon is attended with such marked symptoms that attention was early directed to it. Solleysel described the condition though he regarded the tendon as a nerve. At the end of the eighteenth century this lameness was described by Louchard as dislocation of hock-joint. Bouley, in 1833, correctly explained the condition, and was followed by Rigot, who made the experiment of dividing the

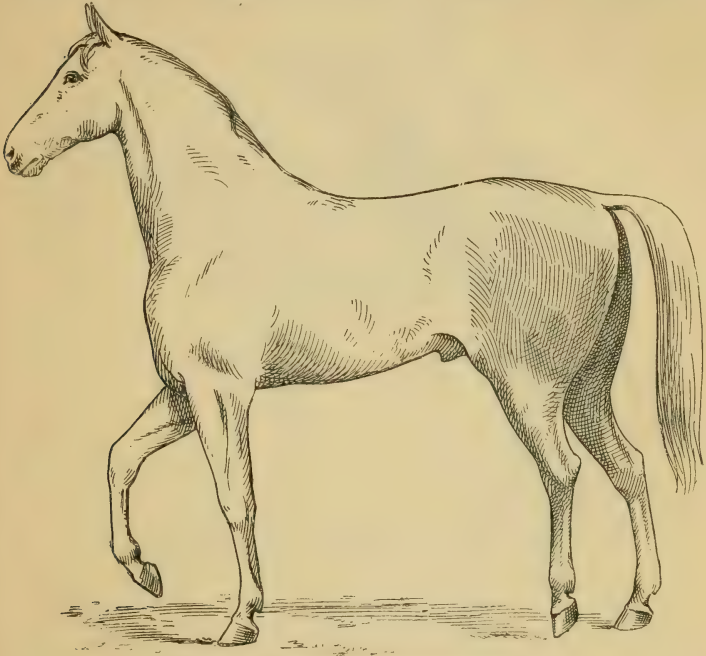


FIG. 528. —Rupture of the flexor metatarsi.

tendon. Hertwig first thoroughly described this lameness, and gave a full account of its origin.

The flexor metatarsi tendon becomes ruptured either in its course along the front of the tibia or at its origin from the pit between the trochlea and external condyle of the femur. In the former case the rupture is usually incomplete, the fibres appearing as though frayed but not completely torn across.

Causes. Rupture of the tendinous flexor metatarsi follows excessive extension of the hock-joint, produced either by the animal kicking violently or struggling in hobbles, or from the limb being

violently drawn backwards, as in shoeing in the travis, or drawn upwards by means of a cord passed through a ring. If, while the foot is thus fixed, the animal fall, rupture is very apt to occur. It may also be caused by efforts to withdraw the foot caught in railway points, or even in deep, soft ground, and sometimes forms a sequel to collisions, slips, or getting over bales.

It seldom follows external violence, though a case is recorded where the muscle was divided by a sharp stone. Klemm recommended section of the cunean branch of this tendon in the treatment of spavin. Rupture seldom affects both limbs, and is rare in animals other than the horse, though several cases are reported in cows. In dogs, the tendon which corresponds to this muscle may be divided as a result of external injuries.

Symptoms. This rupture is distinguished by lameness when the limb is carried, marked flexion of the stifle-joints, and excessive extension of the hock. The symptoms are so marked that the condition can be diagnosed with absolute certainty, even from a distance. As the fibrous band stretching between the external

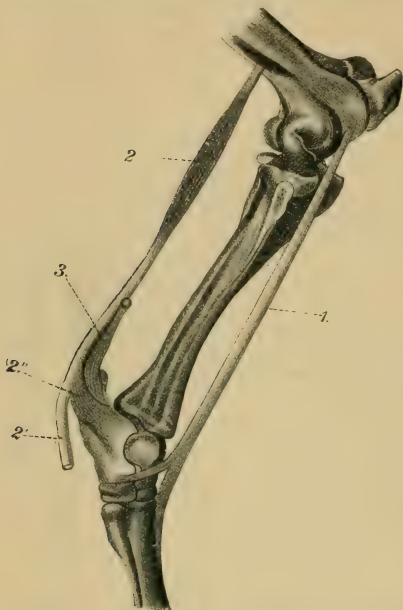


FIG. 529.—Showing the mechanism of the hock and stifle joints. The tendons of the flexor metatarsi and gastrocnemius muscles unite the bones forming the joints in such a way that they are unable to move independently. 1, Tendinous division of the flexor metatarsi muscle; 2, 2', and 2'', flexor perforatus; 3, gastrocnemius tendon.

condyle of the femur and the metatarsus is no longer able to transmit the movements of the femur to the metatarsus, and as the flexor metatarsi muscle itself is powerless to make up for this deficiency, the cannon bone is no longer flexed on the limb but hangs inertly, and all the lower joints of the limb follow suit or are slightly flexed. That portion of the limb below the hock is not properly

advanced, whilst the relaxation of the tendon favours excessive flexion of the stifle-joint. This want of harmony in the function of both joints produces an uncertain movement of the limb, which may give the impression of a broken bone, and has been so interpreted by some. The absence of fracture, however, is at once shown by the fact that the limb can still support weight. The serious symptoms apparent during movement disappear when the animal is at rest. In rupture of the flexor metatarsi, the function of its tendon is in abeyance; while its antagonist, *i.e.*, the tendo Achillis

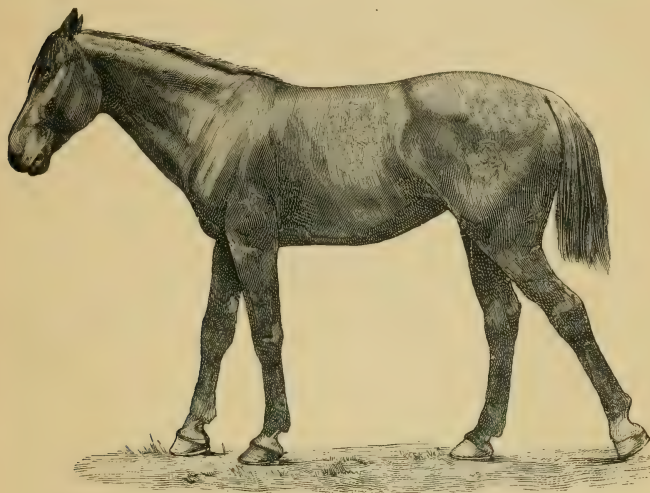


FIG. 530.—Rupture of flexor metatarsi muscle (from a photograph).

is unopposed, appears relaxed, and when the limb is relieved of weight and extended lies flaccid. This appearance is very characteristic, and only occurs in two other conditions, viz., rupture of the tendo Achillis and fracture of the tibia. It is most marked when the hock is excessively extended, as, for instance, by the farrier lifting the limb to remove the shoe. In recent cases the anterior surface of the tibia is sometimes slightly œdematous, in others absolutely nothing abnormal can be seen. Severe swelling with pain on pressure over the course of the flexor metatarsi is quite exceptional, the muscles being clothed in a strong fascia.

Course. The affection is naturally of sudden onset, and at once produces a peculiar lameness. As weight can still be placed on the

leg, and the ends of the tendon retract comparatively little, union is seldom difficult. Judging by the many reported cases, union is almost always complete in four to eight weeks, even when both legs are affected, though one case in a riding-horse lasted for three months. In rare instances recovery does not occur, or is so incomplete as to impair the movement of the hock. These depend on the position of the rupture and on the animal not being rested sufficiently long. Where the tendon is divided in the bursa, or torn away from its point of origin on the femur (a rare occurrence), recovery is less assured, because formation of new tissue remains incomplete, the paratendineum essential to union being absent from the tendon sheath and bursa. It is somewhat doubtful whether in Goubaux's case the tendinous or the muscular portion of the flexor metatarsi was torn away; the point is of little importance. Probably it was the tendinous portion, because muscle is very rarely torn away from its insertion into bone. H. Bouley reports similar cases. As a rule even when the tendon is torn away from its insertion the case finally recovers, though it lasts as many months as the other weeks, and slaughter may be preferable to treatment.

Partial recovery is one of the results of putting the horse to work before union is complete; the newly-formed cicatricial tissue gradually becomes strained and the tendon lengthened, necessarily causing permanent lameness. Excessive extension of the hock, which sometimes occurs during the early stages of union, disappears completely with time. A few cases have completely recovered in twenty-five days; probably the tendon was only partially ruptured.

Treatment is confined to resting the limb. The ends of the fibrous cord are rarely far displaced, and reunion is not difficult. The animal should be kept perfectly quiet for four to six weeks, should be placed on a level surface, and not receive too much bedding. Work protracts recovery, though in isolated cases union occurs despite it; it always takes a long time, however, and may remain incomplete, the tendon becoming elongated and the action permanently impaired. In horses of any value rest is indispensable. Blistering over the course of the affected muscle is unnecessary, and only serves to secure rest. Work can be resumed as soon as lameness disappears.

V.—RUPTURE OF THE TENDO ACHILLIS AND GASTROCNEMII MUSCLES.

RUPTURES of the gastrocnemii muscles and of the Achilles tendon are much rarer in animals than rupture of the flexor metatarsi. They

are oftenest seen in cows, sometimes in both limbs at once, though in horses both rupture and wounding of the tendon and muscles have been recorded. Rupture generally occurs at the lower point of insertion of the Achilles tendon, a portion of the os calcis being at the same time torn away. In cows it has repeatedly been seen at the point where the muscle becomes continuous with the tendon;

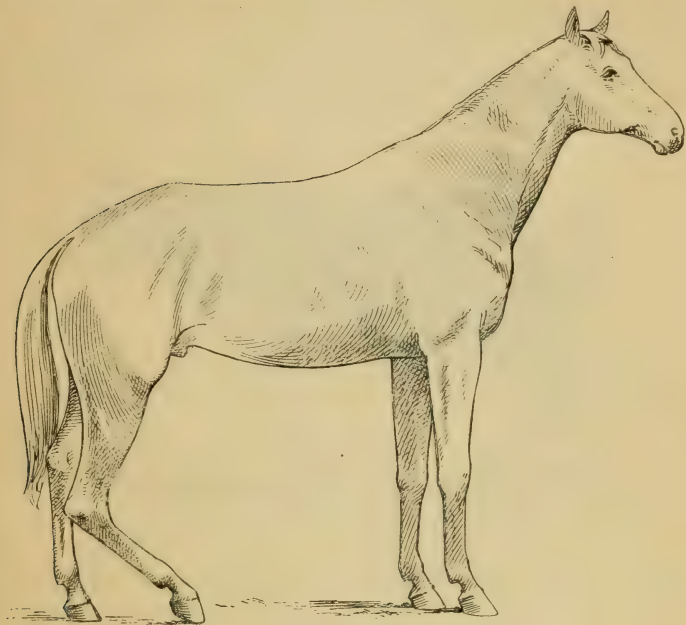


FIG. 531.—Rupture of the tendo Achillis.

but rupture of the muscle itself is known to occur both in horses and oxen. Bayer saw rupture of the tendon in dogs after bruising

Einwächter, in a horse, found not only the gastrocnemius but also the flexor pedis perforatus torn away from the femur. Pirl saw a cow with rupture of the Achilles tendon in both legs. Swelling resulted in the neighbourhood of the popliteal space, and gradually became larger and fluctuating. The cow could only shuffle about on the ground on her hocks.

Causes. Rupture follows violent contraction of the muscle, produced in cattle by leaping one another, in riding-horses by jumping

and in draught-horses by efforts to avoid slipping. The tendon may also be strained by falling from a height, or by the animal slipping with the legs extended under it. In cows rupture sometimes follows long periods of lying with the hind limbs flexed and violent efforts to rise, as in post-partum paralysis. The injury may involve both muscles or the entire tendon, or may remain confined to certain portions; the latter is, however, the exception, complete rupture the rule. In small animals, like dogs, rupture may be produced by the animal being caught in a door. In the horse the Achilles tendon is sometimes cut through. Traumatic inflammation of the os calcis or tendo Achillis, or suppuration in the tendon sheath, may also

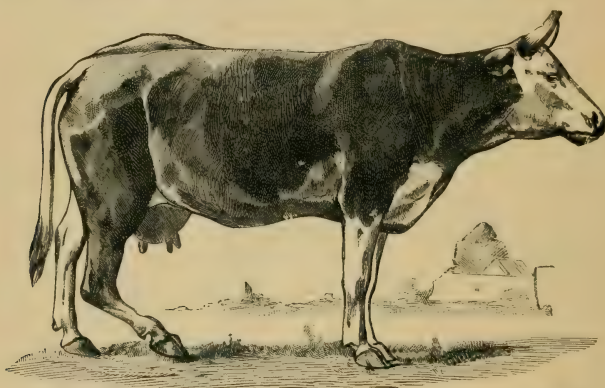


FIG. 532.—Rupture of the tendo Achillis (after Stockfleth).

lead to rupture of the tendon. St. Cyr therefore distinguished primary and secondary rupture. Uhlich saw rupture soon after recovery from influenza.

Symptoms. When the muscles named or the Achilles tendon are completely torn away from their insertion, there is severe supporting-leg lameness, inability to bear weight on the affected limb, and flexion of all joints.

The Achilles tendon extends to the point of origin of the gastrocnemii muscles, and when weight is placed on the limb serves the purpose of fixing the joints, especially the hock and stifle joints. It therefore fulfils an important part in supporting the body, and its rupture is followed by collapse of the limb—the hock sometimes descending sufficiently far to touch the ground (Fig. 532). The excessive flexion of the hock increases the distance between the

points of origin and insertion of the flexor pedis, and the phalanges take up a position of excessive plantar flexion. The hock can also be flexed to an unusual degree by the exertion of a little force. As a rule, a depression may be noted in the course of the tendon or swelling in the gastrocnemii muscles; the tendon appears relaxed even when the limb touches the ground. In incomplete rupture lameness is shown when weight is thrown on the limb, and there is more or less pronounced flexion of the joints, particularly of the hock-joint.

The prognosis depends almost entirely on whether the uninjured leg can sustain weight until union occurs. Small animals, like dogs and cats, almost always do well, but larger animals, as St. Cyr pointed out, are less favourably circumstanced. They sometimes succumb to the continued standing or lying, for union takes from four to six weeks, and under some circumstances may be protracted for several months. Oxen do best lying, but as horses are obliged to stand, it becomes a question whether laminitis may not supervene in the other foot. Nevertheless a considerable number of recoveries have been recorded in the horse. The grounds for forming a prognosis are so slight that it is generally more prudent to withhold it, and watch closely for unfavourable symptoms. As a rule, in the horse the hind feet are more liable to contract laminitis than the front, although they bear less weight—a fact to be kept in mind when one limb is disabled. In small animals recovery is more probable, and if other means fail, an attempt may be made to suture the tendon.

Union is more rapid when the tendon is ruptured than when it is torn away from the os calcis. Partial ruptures, in which some weight, however slight, can still be placed on the limb, are more hopeful. As a rule, the more marked the degree of flexion, the slighter the chance of recovery. Recovery is often protracted by elongation of the tendon and consequent lameness.

Treatment. In small animals the hock-joint should be as much as possible extended and a plaster bandage applied. Larger animals, like horses, are slung, so as to keep the hock continuously extended and the ends of the divided tendon or muscle as close as possible. In quiet horses this may be assisted by bandaging and applying adhesive plaster. Such a dressing certainly allows of some movement, but for this very reason is better borne than the rigid plaster bandage or than splints. St. Cyr stated that the latter are apt to produce excoriation, and that it is often better not to check movement. Martens saw the divided Achilles tendon unite in two months without the horse being slung, and Grüner in two and a half months. Light

horses, when rising or lying down, are better able to protect the injured limb, and may be left free in a box, though even then a dressing is useful, if the animal does not attempt to displace it by violently flexing the limb. In cows, Detroye applies a gutter-shaped splint to the back of the hock-joint, and fastens it by straps to the tibia and metatarsus; others employ two lateral splints of wood, shaped to the leg and secured by straps and adhesives.

Wounds of the flexor tendons heal with still greater difficulty unless rendered aseptic, but that asepsis is quite possible is shown by Martens' and Grüner's cases. Particular precautions are necessary in injuries about the tuberosity of the os calcis.

D. DISEASES OF THE HOCK.

I.—FRACTURE OF THE BONES OF THE HOCK.

(a) **FRACTURE** of the os calcis. Fractures of the bones of the hock are, on the whole, rare, though cases have been seen, especially of the calcis and astragalus bones. Apart from those described above in which the Achilles tendon is torn away from the tuberosity of the calcis, fractures of this bone are produced by external violence, by kicks, or sometimes by blows with the farrier's hammer. Detroye saw three cases—one in a horse, one in a steer, and one in a calf. The horse had produced the fracture by slipping when rising in the stable. The bone was broken just above its articulation with the astragalus. In the steer, fracture was caused by mounting a cow, and in the calf, by falling into a ditch. The same causes which produce rupture of the Achilles tendon may of course lead to fracture of the os calcis.

The symptoms and course closely resemble those of rupture of the Achilles tendon, which in this fracture also loses its lower point of insertion, though fracture of the calcis is generally more painful than rupture of the tendon. The broken fragment is drawn upwards by the tendon, and the animal is totally unable to stand on the limb, which collapses. All the joints are excessively flexed, particularly the tarsus. In moving, the limb is lifted and the metatarsus and phalanges dragged, the tendo Achillis and perforatus appearing relaxed. Crepitation is sometimes heard, whilst in compound fractures splinters of bone may possibly be detected in the wound.

In horses and oxen treatment is rarely successful, but in small animals, which offer some chance of recovery, it may be attempted. Union is rendered difficult by the displacement of the fractured parts consequent on the pull of the Achilles tendon, by their defective

nutrition, and by the inability of large animals to stand continuously on the other hind leg, though Bräuer says he cured oxen in four weeks by applying a plaster bandage. Detroye reports a similar case in a steer: the lameness completely disappeared after a time. Haase likewise reports union in the horse, though the case lasted from twelve to fourteen weeks. It would be interesting to attempt the reunion of fractured os calcis in the dog or other small animal by wire sutures, or by screwing the fragments together with silvered wood screws. This particular operation does not seem to have been attempted hitherto. It would demand perfect technique, but appears, *à priori*, within the range of possibility.

The prognosis, therefore, depends, firstly, on the degree to which the fragments are displaced (sometimes dislocation is minimised by the insertion of the flexor pedis perforatus); and, secondly, on the length of time during which the animal can stand on the other foot without laminitis setting in. Compound fractures may generally be looked on as incurable.

Treatment is in general similar to that in rupture of the Achilles tendon. In these cases also it is important to fix the hock-joint in as complete extension as possible. Plaster bandages are useful for small animals.

(b) Fracture of the astragalus is also rare; it follows forced rotary movement of the limb whilst the animal's weight is upon it, or whilst it is fixed to the ground. A heavy cart-horse was seen to produce this fracture by suddenly turning round. A case of Furlanetto's in a cow was caused by falling into a ditch.

The symptoms are: sudden and severe lameness, shortly followed by fluctuating painful swelling of the astragalo-tibial joint, similar to that in inflammation of the hock-joint. Crepitation can sometimes be detected by placing both hands around the joint and moving the lower part of the limb. In other cases it is absent, and the condition may be mistaken for violent strain of the joint, which, however, is rare, or for severe subfascial cellulitis; but as the latter is accompanied by swelling of the local lymph vessels and by fever, it is sufficiently distinct from fracture of the astragalus.

Prognosis is nearly hopeless, because the fracture always extends into the joint, recovery is extremely protracted, and no weight can be placed on the limb. It is therefore better to slaughter large animals without delay. An attempt at treatment may be made in cats and dogs by applying a plaster bandage, which should be put on whilst the leg is moderately extended, so as to limit as far as possible the lameness which will result from obliteration of the joint. The cases

described by Furlanetto certainly recovered, but proved permanently lame.

(c) Fractures of the other bones of the hock are less frequent than those above mentioned, and are either due to kicks, to the animal being run over, or to similar violent mechanical causes, or they appear in connection with sprains and luxations. Thus Rey found dislocation of the hock-joint between the scaphoid and cuneiform magnum in a horse which had caught its hoof between railway-metals and had fallen. The external small metatarsal was torn away from the large metatarsal and the cuboid bone crushed.

Diagnosis is seldom difficult, though the seat of fracture can only be determined by post-mortem examination. There is abnormal mobility of the hock-joint, especially for movements of ad- and abduction; crepitation is often audible.

The prognosis is generally bad, but depends on the degree of lameness, and is, of course, influenced by the presence or absence of other injuries and the nature of the animal's work.

II.—LUXATION AND SPRAIN OF THE HOCK-JOINT.

THE strong ligamentous apparatus and the interlocking of the articular surfaces of the astragalus and tibia form so perfect a means of union that luxation of this joint must necessarily be of the rarest occurrence. In horses, it is doubtful if any have been reported, for even Louchard's case appears only to have been a severe strain, probably accompanied by fracture of the malleoli of the tibia or of the astragalus. Stockfleth describes having discovered by post-mortem examination inward luxation of the astragalus in a sheep; the capsule of the joint was ruptured. He also saw displacement between the astragalus and upper row of small hock bones in a cat which had fallen, hind legs first, from a height; the metatarsus was thrust outwards. The displacement was immediately reduced, a rubber bandage applied, and the animal recovered. In a rabbit which had also fallen from a height, Stockfleth found displacement of the astragalus. In a horse, which had passed its left hind foot through a hole in a wooden bridge, Haubner discovered rupture of the ligaments connecting the metatarsus and lower row of hock bones. The limb was excessively movable, and showed, at the seat of curb, a depression. Frick saw incomplete outward displacement of the astragalus in a dog; the lower, inwardly-projecting end of the tibia was supported by a new osseous growth covering the inner surface of the astragalus.

Schrader says that one of Havemann's pupils cured a cow suffering from luxation of the metatarsus. Townshand reports a similar case: the metatarsus was displaced in a forward direction. The animal recovered, but always went lame. In Rey's case, above cited, the union between the hock bones was divided, but there was no displacement. Stockfleth speaks of a similar case in which the astragalus and calcis were torn away from the cuboid and scaphoid bones; the horse was killed. Ruffert also saw a case in which the internal lateral ligament and portions of the interosseous ligaments were ruptured. Union appears to be strongest between the metatarsus and lower row of hock bones; Stockfleth only gives one case of dislocation at this point. It occurred in a dog; all the ligaments and flexor tendons were ruptured, and the lower part of the limb hung by the extensor tendons. Needless to say, in these cases recovery is often extremely protracted and difficult, for which reason it is usually best to advise slaughter.

III.—WOUNDS AND ACUTE INFLAMMATION OF THE HOCK-JOINT.

WOUNDS are by far the most frequent cause of acute inflammation of the hock-joint. They may be caused by thrusts with forks, lances, or sabres, by kicks, by accidents in jumping, by barbed wire, and in dogs by bites, or they may be due to operation for spavin or for synovial distension. Point firing sometimes causes suppuration in the hock-joint. Inflammation of the tendon sheath of the flexor perforans at the inner side of the hock or septic cellulitis near the joint may sometimes extend to it; or, again, the joint may be opened by necrosis consequent on lying long in one position. Acute inflammation of the tibio-tarsal joint also results from wrenching, and in horses is sometimes seen after strangles and other infective diseases. Inflammation of the hock-joint, probably of metastatic origin, has been observed in cows soon after calving, sometimes in both limbs at once. The cases usually followed retention of the foetal membranes, post-partum paralysis, mastitis, and septic metritis. Foals, calves and lambs often show inflammation of the hock-joint in omphalo-phlebitis or "navel disease." Morot and others have seen tuberculosis of the hock-joint in cattle. Dieckerhoff describes several instances of spontaneous inflammation of the hock-joint, which proved on post-mortem examination to be of a purulent character. Whether the cases of rheumatic inflammation so often described are caused by exposure to cold is uncertain.

Symptoms. The local injury generally dispels any doubt as to

the character of the disease, especially if synovia is being discharged. There is always more or less swelling, which extends round the joint, and both upwards and downwards; though soft at first, it later becomes hard and resistant. The distension of the tibio-tarsal capsule is often masked by the periarticular swelling. From the first lameness is severe, and is exhibited both when the limb is being advanced and when weight is placed on it (mixed lameness). Fever is present in the purulent or septic variety of disease, and periarticular abscesses nearly always form.

The disease can only be mistaken for severe subfascial cellulitis



FIG. 533.—Exuberant granulation in front of the hock.

(see "Wounds and Injuries of the Lower Thigh and Leg"), but as this exhibits all the above-described symptoms, some time may elapse before the diagnosis becomes assured. If the condition improves after the abscesses break, and especially if lameness decreases, the joint may still prove intact, but improvement is sometimes only apparent, and due to laminitis in the other foot, from the animal continually standing. Increased pulsation in the metatarsal arteries points to the occurrence of laminitis and displacement of the os pedis.

Fractures of the malleoli of the tibia and of the astragalus cause similar symptoms, and,

unless accompanied by crepitation, are very difficult to diagnose.

Injuries to the front of the hock are also difficult to treat, especially when large flaps of skin are destroyed. The unavoidable movement of this joint in horses irritates the wound, causing active granulation, which is sometimes impossible to repress. Fig. 533 shows such a condition, photographed from nature.

Course and prognosis. The course depends principally on whether the parts remain aseptic. If they do not, recovery is highly improbable, and oxen should be slaughtered before they have lost much condition. The prognosis is therefore doubtful in all cases of inflammation caused by external injury or by metastasis, though

inflammation is less dangerous in the lower, less mobile portions of the hock than in the tibio-tarsal joint, in which the destruction of the articular cartilage is always followed by severe and permanent lameness. In the smaller joints, inflammation may lead to obliteration of the joint and restoration of the animal's usefulness. Provided the wound remain aseptic, there is less danger. Such cases are more particularly seen in cows after parturition. Slight cases, *i.e.*, those where inflammation is not marked, heal in fourteen days, but the more severe take four to six weeks.

Treatment follows general principles. If the joint be injured efforts must be made to preserve it. Small, and especially perforating wounds must first be carefully cleansed, disinfected and covered with iodoform, or an ointment of sublimate, with lard or paraffin (1—10), may be applied. The swelling produced by the irritant leads to rapid closure of the wound, and prevents infection of the joint. Large wounds, particularly those of an incised character, should be thoroughly disinfected and sutured. Quiet horses may be slung, and a surgical dressing applied; but when this cannot be used, and it is impossible to suture the wound on account of extensive bruising, permanent irrigation offers the best means of preventing infection of the joint. Lorenz cured a wound in a horse's hock by irrigating with 1 in 5,000 sublimate solution, and afterwards blistering.

If purulent or septic inflammation has already attacked the tibio-tarsal joint, little can be done, though irrigation with disinfectants may be tried. Washing out the joint with dilute disinfectants like 1 in 1,000 to 1 in 2,000 sublimate solution has not hitherto proved very successful, but it might be tried when the joint is opened. Syringing with disinfectants is useful in wounds in the lower portions of the joint.

Hydrogen peroxide solution has been recommended, and success has once or twice followed its use in open hock-joint. Hohmann opened the hock-joint of an ox and evacuated some fibrino-purulent fluid. Healing occurred under permanent irrigation.

To prevent excessive granulation in the bend of the hock, the animal should be tied up short, and every precaution taken to limit movement of the hock-joint: the granulating surface is treated on general principles.

IV.—CHRONIC SYNOVITIS OF THE TIBIO-TARSAL JOINT. BOG SPAVIN.

Bog spavin consists in excessive distension of the anterior capsule of the true hock-joint. The capsular ligament is attached above to

the tibia, below to the astragalus, scaphoid, and large cuneiform bones, and on either side to the lateral ligaments of the joint. Bog spavin varies considerably in size, but in well-marked cases the distension is associated with two smaller dilatations (articular thoroughpin) on the lateral surfaces of the hock, as may be proved by applying pressure to the bog spavin. Compression of the anterior distension increases the lateral dilatations, and *vice versa*. In some instances distension of the tarsal sheath of the perforans tendon (tendinous thoroughpin) co-exists with bog spavin, but as a rule there is no communication between the joint and the tendon sheath.

Bog spavin is commonest in young horses with straight or upright hocks, but it is also frequent in aged stallions and breeding mares. It is due to chronic synovitis, brought about by wear, hard work, debilitating disease, or accident; occasionally it follows acute synovitis. It is often regarded as indicating inherited weakness of the hock-joint.

The most noticeable **symptom** is the presence of a fluctuating swelling on the antero-internal aspect of the hock. Lameness is exceptional, though sometimes owing to large size of the distension there is stiffness or restricted hock action. If bruised or injured, bog spavin may cause serious symptoms, acute synovitis may ensue, the joint may burst, and the patient's life may be endangered. Acute (closed) synovitis is distinguished by great lameness, fever, sweating, inappetence, and intense suffering; and locally by tense, hot, very painful swelling of the hock. (See also "Acute Inflammation of the Hock Joint.")

Treatment must follow general principles. Recent swellings are treated by cold applications, and later by blistering. As firing only diminishes the swelling, and always leaves visible scars, it merely substitutes one blemish for another; nevertheless, Stockfleth recommends it. In young horses, with moderately developed bog-spavin, repeated painting with tincture of iodine or massage may diminish swelling, but seldom removes it completely. In foals treatment is rarely of permanent value, and relapses often occur. Spring trusses are often applied, and occasionally succeed in reducing the distension, which, however, is apt to recur when treatment by spring or elastic pressure has been discontinued.

Caution is required in operating surgically. Removal of contents by Pravaz's syringe or a slender trocar is occasionally followed by benefit, and injection of iodine may be tried. In most cases the operation must be repeated several times, at intervals of four to six weeks, to be of service. Evacuation by Pravaz's syringe, washing

out with 1 in 1,000 sublimate solution, and the application of a blister was recommended by Zimmer in 1890. Deans has practised the above operation (evacuation and injection) and claims to have had considerable success. It probably constitutes the most hopeful method of dealing with this condition, but demands careful antiseptic precautions.

Horn draws off the contents with a trocar, and applies, in place of a pressure bandage, a thick layer of glue, in which finely chopped tow is mixed to increase its strength. Incising the swelling is not unattended by danger, even where full antiseptic precautions are taken, because the animal sometimes rubs off the dressing. Proceeding with full



FIG. 534.—Spavin formation on left hock (seen from in front).



FIG. 535.—Spavin formation on right hock (seen from behind). A, Spavin.

antiseptic precautions, Qualitz, in one case, removed a lozenge-shaped fragment of skin and synovial membrane about $1\frac{1}{8}$ inch wide from the outer surface of the hock, and by suturing the parts, irrigating with an antiseptic solution, and covering the wound with a surgical dressing, was able to secure healing in a fortnight. This success, however, must be regarded as exceptional, and should not encourage one hastily to attempt its repetition. Acupuncture has been recommended by Gloag and others. The swelling is perforated on either side to a depth of $\frac{5}{8}$ th of an inch by an apparatus composed of four needles thrust into a cork, when the fluid-contents escape. In five days the operation is repeated, iodine ointment rubbed in, an elastic bandage applied over all, and left in position for twenty-four hours.

Treatment of **acute synovitis** of the hock-joint is never very

hopeful. The inflammatory symptoms may gradually subside and the disease assume a chronic course; or the joint may burst, or suppurate. So long as only synovia escapes from the opening, recovery may follow treatment by continuous irrigation; but when suppuration occurs, the horse suffers intensely, rests little even when in slings, rapidly loses flesh, and owing mainly to exhaustion, arising from fever, failure to feed, and loss from wound discharge, slaughter becomes imperative.

V.—CHRONIC INFLAMMATION OF THE HOCK. SPAVIN. ARTHRITIS CHRONICA DEFORMANS TARSII.

FOR a long time the nature of this disease remained obscure, and it was sometimes thought to be a bone affection, sometimes an affection of the ligaments. Havemann first directed attention to the disease of the articular surfaces, and Schrader and Schütz afterwards described the condition thoroughly. At the present day no doubt exists that spavin is due to chronic inflammation of the hock, and the only question is, in what structure does the disease originate?

The view that the bone tissue forms the primary seat of spavin disease is old, but has again been advanced by Gotti and others, who suggest that spavin should be regarded as a chronic deforming osteoarthritis. According to the very careful investigations of Gotti, whose accuracy has been confirmed by Bayer, Fröhner, and Eberlein, spavin begins as a slowly developing rarefying osteitis of the cuneiform, scaphoid, and metatarsal bones, and gradually extends to the articular surfaces, or towards the periphery, or in both directions at the same time. In the rarefying process the bones undergo partial decalcification, with the formation of spaces containing granulation tissue. Condensing osteitis or osteo-sclerosis follows the rarefying osteitis, but for a time the articulations and periosteum may remain intact; eventually, however, by extension of the disease, lesions appear in the articular cartilages (deforming arthritis, central ankylosis), or at the free borders of the bones (spavin enlargement, peripheral ankylosis), and finally the affected bones become fused into a single mass. Hertwig, and the Günthers are among the supporters of this theory. Dieckerhoff, Lafosse, and Hoffmann believe the disease originates in the bursa of the cunean branch of the flexor metatarsi.

Anacker, Joly, Möller, Schütz, and Smith believe spavin to be an arthritis chronica deformans. The view that the articular surfaces are first invaded was held by Bouley, Dieterichs, Gurlt, Havemann,

Hering, Schrader, Stockfleth, and Träger. The ligamentous apparatus is considered to be the primary seat of disease by Aronsohn, Bartels, Barrier, Hess, von Hochstetter, Roloff, and Pflug.

An unprejudiced examination of the foregoing views can only lead us to the conclusion that to regard spavin as invariably originating in one of the regions named, *i.e.*, to consider it as a fixed and invariable disease, is an untenable position. The variations in the anatomical changes discovered by different observers are due less to the stage at which the disease has arrived than to fundamental differences in its nature. Depending on whether the spavin has arisen from disease of the bone or of the ligaments, the anatomical changes will vary. Only on this hypothesis can we explain why in one case a large exostosis is accompanied by spurious ankylosis, and in another a scarcely visible bony enlargement is found along with true ankylosis between the cuneiform bones or between the cuneiform and the metatarsus. For this reason, Frick, whilst keeping an open mind as to the essential nature of spavin, declares that the most varying forms of chronic disease of the inner surface of the hock may produce the clinical appearances which, in practice, we recognise as "spavin." Anatomically, spavin may be divided into various forms which, however, may all be regarded as having one point in common, *viz.*, that they eventually lead to deformity of the affected joint, and may, therefore, rightly be designated as *arthritis chronica deformans*. In a word, "spavin" is a collective clinical term covering a number of extremely diversified anatomical changes in the hock.

Pathological anatomy. Examination reveals :—

(1) Changes in the articular cartilage of the cuneiform, and of the upper part of the metatarsus, sometimes of the scaphoid, and other bones of the hock. Changes in the cartilage, abrasions, ulceration, and, at the borders of the articular surfaces, rugged, uneven swellings, produced by thickening of the cartilage, which later becomes ossified, can all be detected by the naked eye. Microscopically, the inter-cellular substance is seen to be fibrillated, and the cartilage cells to be undergoing multiplication, processes peculiar to *arthritis chronica deformans*.

(2) The affected bones show deposits termed osteophytes, which sometimes start from the ossified cartilaginous growth, sometimes result from inflammation attacking the periosteum of the bones named. Gotti and Eberlein state that the bone shows rarefying and condensing osteitis.

This local growth of bone is in fact the so-called spavin. It is usually only a secondary symptom due to inflammation extending

from the articular surface to the periosteum or fibrous covering of the free margins of the bones.

(3) Changes in the ligaments and synovial membrane. Both the villi and borders of the synovial membrane seem thickened and very vascular. Sometimes the secretion of synovia is excessive. The ligaments of the joint, and the connective tissue surrounding it, are also thickened.

(4) In advanced stages of the disease, the smaller joints may be obliterated, especially those between the scaphoid and cuneiform bones, and between the cuneiform and metatarsus. This ankylosis may either be central or peripheral. The ligaments are then often ossified, and so surrounded by new growths of bone that they can scarcely be recognised. Sometimes the cunean sheath of the flexor metatarsi tendon becomes diseased. Petit states never having found this part of the hock-joint diseased even when extensive exostoses existed.

In many cases pathological processes are confined to the lower and inner portions of the hock, though not infrequently they extend further, invading the cuneiform bone, the inner small metatarsal, and even the astragalus, cuboid and external surface of the joint. French observers, therefore, distinguished "*éparvin tarso-métatarsien*," as opposed to the disease of the cuneiform bones and metatarsus, which is termed "*éparvin métatarsien*."

The appearance of the above-described changes, either alone or in combination, is easily explicable on the theory that the point of origin of the disease varies. Menveux made a collection of hocks, showing widely varying anatomical changes, from horses, all of which had clinically been recognised as suffering from "spavin."

Causes. In no other disease is the division of causes into *causa externa* and *causa interna* so well warranted and so practical as in spavin. The *causa interna* is a predisposition partly dependent on the conformation of the hock, partly on that of other portions of the body. Whilst the complicated mechanism of the hock predisposes to disease, and especially to inflammation, this tendency is enormously increased by defective formation of the joint. It is scarcely needful to say that, under the powerful action of the muscles of the hind limb, small, cramped joints are more likely to suffer than those having well-developed, broad and ample articular surfaces. Defective development of the lower portions of the hock and of the upper end of the metatarsus, the condition described by horsemen as "*tied-in hock*," is particularly disastrous, while a distinct curvature (sickle-shaped hock) is almost as bad. In this formation the action

of the muscles of the hind limb produces excessive movement of the hock-joint and great pressure on the articular surfaces, with danger of injury to the ligaments of the joint.

But these visible peculiarities of formation are not the sole causes of spavin: the intimate structure of the bones and ligaments may predispose to disease, as shown by the inheritance of spavin, and its occurrence in entire strains of horses with hock-joints perfectly formed. In breeding, therefore, special attention should be paid to this disease. The exact nature of the predisposition at present eludes us, though by many it is considered to result from incomplete development of the bones and ligaments. Working immature animals is also a potent cause. Horses which might work quite satisfactorily at five or six years old, not unnaturally develop spavin at three or four.

In considering the question of predisposition, we have to remember that the formation of other portions of the limb, and even of the body, exercises a considerable influence on the development of the disease. Experience shows that uprightness of the fetlock- and stifle-joints favours hock disease, though this formation is often secondary, *i.e.*, a consequence, and not a cause, of the formation of spavin. Klemm considers that animals with cow-hocks, and those which stand with the hind-feet far back, are predisposed to the disease, and on this basis explains the curative action of shoes with high quarters and deep heels.

Peters thinks that turned-out hocks are particularly prone to spavin, and there is no doubt that this formation interferes with hock action and increases the chance of disease.

Experience also shows that very powerful horses with broad and well-developed quarters are particularly liable, the reason being the great strain which this formation throws on the hock-joint. The more powerful the muscles of the hind-quarter and the freer the movement, the greater the strain on the hock. The same is true of over-grown and long-backed animals. To produce an equal output of energy, their muscles are forced to act more vigorously, and, therefore, greater strain is thrown on the hock. For the same reason powerful, spirited horses more often suffer than quiet, phlegmatic animals. The fact that spavin is commoner in young horses is principally due to the incomplete development of their bones and ligaments, and to the existing predisposition being only brought into play when the young animal is put to work; horses, when once seasoned, not being so likely to develop disease unless greater demands are made on their working powers, or the hock is accidentally injured.

The *causa externa* is almost exclusively represented by mechanical injury. Severe, rapid work, especially under the saddle, or in front of heavy loads, often produces slight, frequently repeated strain. Peters thinks soft ground and rough pavements particularly injurious, because the unavoidable rotary movement of the hoof on the ground is interfered with, and consequently takes place, not at the extremity of the limb, but in the joints, especially in the hock-joint.

Single violent sprains, produced, for example, by wheeling round on the hind-quarters or suddenly throwing the horse on its haunches, may determine inflammation of the hock-joint, but this is far from common. Even less frequently is inflammation caused by external injuries, such as wounds or bruises.

Frick, who lived for a long time in the mountainous parts of Schleswig states that, with the exception of being rather "leggy," the horses there are well shaped. Nevertheless it very often happened that when worked the animals developed acute lameness, with swelling, heat, and pain on the inner side of the hock-joint. The lameness was similar to that of well-marked spavin. Cold local affusions and rest removed the symptoms in three to four days, but very soon after, enlargement of the inner side of the hock and lameness reappeared and the existence of "spavin" could no longer be overlooked.

Frick, therefore, regards strains as playing the chief part in the causation of spavin. The formation and function of the hock naturally favour injuries of the kind, and Frick, after careful study, is convinced of the truth of this view. As in every other form of strain, the anatomical lesions may vary, and it is this variation in clinical appearances which has caused different observers to formulate such widely differing views as to the exact nature of spavin.

Although agreement has not been reached as to the initial lesion of spavin, the views regarding its pathology are more in accord. Anatomy and physiology here play the chief part. The peculiar fact that the disease affects the inner side of the hock has always attracted attention, and has given rise to much speculation.

Peters sought an explanation in the anatomical formation of the parts. As the connection between the tibia and astragalus consists of a ginglymoid, or, more correctly speaking, a screw-like, joint, in which the powerful lateral ligaments limit both abduction and adduction, and only allow of movement in the direction of the longitudinal axis of the body, one would expect that the axis of the joint would be perpendicular to that of the body. This is not the case, however; the (horizontal) axis of the joint lies obliquely to it, and,

starting from the inner side, runs backwards and outwards. As a consequence, the two tibiæ are not parallel, but converge from above downwards, whilst the metatarsal bones of the two limbs are parallel with each other when the limbs are in their normal position. It therefore results that the power does not act perpendicularly to the articular axis of the astragalus, and consequently, when weight is placed on the limb, the muscles do not simply extend the joint, but also tend to rotate it. This arrangement certainly assists the transference of the body-weight to the opposite limb and ensures stability; but the consequent rotary movement of the limb necessarily involves displacement of the bones of the hock-joint, and thus favours strain of the ligaments and disease of the joints. The tibio-tarsal joint is protected against injurious action of this kind by its strong lateral ligaments, and by the prominences on the astragalus; whilst the inner portion of the lower joint, which can easily be shown by anatomical preparations to possess the least power of resistance to such rotary movements, has therefore to take the chief share in them and accordingly is most exposed to strain of its lateral ligaments and fibrous capsule. Irritation and inflammation are thus caused in the neighbouring periosteum, and produce disease of the articular cartilage. Depending on whether the cartilage and synovial membrane become affected early or late, lameness is either present from the first, or only occurs when new bony growths have formed outside the joint. This, again, depends principally on whether strain is severe from the first, or whether it is only gradually exerted.

This theory seems to explain in a satisfactory way both the manner of origin and many of the symptoms of spavin. Anything which impedes this physiological rotation of the hock-joint, such as working in heavy ground or on rough pavements, must favour the production of disease. It seems tolerably certain that spavin cannot be referred to any single cause, but that the initial disease may start in one of several structures; and therefore, while the formation of the joint on which Peters thus lays stress is probably one of the most important factors, it would be unwise to deny the possibility of the process originating in disease of the bursa of the flexor metatarsi (Dieckerhoff), or even on the surface of the joint. Möller's and Petit's investigations, however, showed the bursa to be frequently intact, even when disease of the joint was advanced. Nor does co-existent disease of the bursa necessarily prove the latter to have been the point of origin, for in many cases it becomes affected secondarily, by inflammation extending to it from the joint.

Symptoms. (1) Spavin lameness. The diagnosis of arthritis chronica in small, "clean" hocks offers no difficulty, provided disease processes have extended beyond the joint, and exostoses exist. Until they develop, however, diagnosis remains uncertain, for the lameness is not sufficiently characteristic to form the basis of a decided opinion. It is just on this account that errors so frequently occur, and that other lamenesses, even foot-lameness, are mistaken for spavin. But other injuries to the hock, such as sprain, &c., may lead even experts into error. Such mistakes often lead to doubts being cast on the value of treatment.

The lameness accompanying spavin is scarcely ever sufficiently distinctive alone to determine the diagnosis, but must be considered along with the anatomical changes in the hock-joint.

Even Knoblock, when speaking of it, says: "If one detects no swelling, how is one to know that a spavin will come?" One must not be understood to say that the character of the lameness does not afford valuable information, but the kind of lameness is less important than the manner of its appearance and its after-course, and, finally, than the absence of visible pathological changes to which the lameness could otherwise be referred.

The onset and course of the lameness are, then, of greatest value; the style of movement, which varies greatly according to the position and extent of the inflammation and to other circumstances, much less so. In the greater number of cases the limb is incompletely extended. The last phase of the stride, while weight is still carried by the limb, is relatively shortened, apparently on account of the pain due to extension of the hock-joint. Immediately the hoof leaves the ground the limb is drawn rapidly forward. This sudden movement often resembles stringhalt, and is best seen during the first few steps, or when turning in a small circle.

A further consequence of the incomplete extension of the limb is an exaggerated hip-action, which is seldom absent. The shortening of the last part of the stride is compensated by extra movement of the quarter. Sometimes the limb is abducted, especially in double-sided spavin, in which the turning out of the limbs is often well marked. In other cases the fetlock becomes upright, in consequence of the incomplete extension of the hock causing the animal when moving over uneven ground to walk on the toe. In almost all established cases the horse *wears the toe of the shoe* excessively.

As a rule, lameness develops very gradually. At first it disappears after a few steps, and in many cases all that can be observed is a catch in the movement of the affected limb, resembling stringhalt, when

turning round in the stall towards the sound side. This usually disappears with work. The disappearance of lameness during movement, and its regular recurrence after rest, form one of the most important peculiarities of the disease. The fact that turning towards the sound side seems more painful than towards the diseased is explained by the pressure on the inner part of the hock being then greater. Occasionally, however, cases occur in which the lameness persists during movement, and may, indeed, become more severe, and the hock may show little if any enlargement ("occult spavin"). The increase in lameness when turning in small circles is clearly due to the rotary movement in the limb and the tendency to displacement of the bones in the affected section of the joint.

The "spavin test" consists in lifting the limb and keeping the hock-joint flexed for one minute and then trotting the horse. Lameness may be very marked for a few steps. This test, however, requires to be used with considerable care, especially in old horses, which may show similar difficulty in movement after the limb has been kept bent, even without having spavin.

Various hypotheses have from time to time been advanced as to the immediate cause of lameness. Whilst the older practitioners considered the pain to be due to pressure of the exostosis on the periosteum, and supported their view by reference to the uneven surface of the macerated bones, we have known since Havemann's time that the changes within the joint are not only the essence of the disease, but also the cause of the lameness. Though Hering opposed this, stating that spavin lameness is sometimes seen without disease of the joint, either his observations were due to errors in diagnosis, or the process was only in a developmental stage, the articular surface not yet having suffered. As a rule, the onset and course of the lameness entirely agree with the observations made in men suffering from arthritis chronica, who at first only show lameness for a few steps. The lameness is probably due to changes partly in the articular surfaces, partly in the ligaments. Dieckerhoff adds disease of the bursa of the flexor metatarsi muscle. It seems doubtful whether chronic inflammation of this bursa ever produces lameness.

(2) The exostosis may even precede the lameness in cases where the disease develops slowly: as a rule, the two appear simultaneously, but sometimes the bony swelling does not occur until many weeks afterwards. Its detection requires an accurate knowledge of the normal configuration of the hock-joint, and may be effected by viewing the joint either from the front or back. For this purpose

the observer takes up a position either some steps in front of or behind the horse, and compares the inner surfaces of the hocks. In this way experts can detect the slightest differences, though it is by no means possible to determine by this examination alone whether or not spavin exists, especially in well-bred horses, whose hocks are seldom absolutely symmetrical. But even in other animals a want of symmetry in the hocks cannot of itself be regarded as a certain sign of spavin. The terms "coarse," &c., used in speaking of formation, are tacit acknowledgments of this fact, and are often only circumlocutions for spavin.

(3) The above signs of spavin are often accompanied by atrophy of the muscles of the quarter, as usually happens in chronic painful lamenesses. Eberlein also states having been able to demonstrate atrophy of the diseased hock by actual measurements. The upper part of the affected joint was sometimes 2 inches less in diameter than that of the sound one. Even at the level of the exostosis (spavin) the measurement was lessened. Eberlein regards this as due to atrophy of inaction.

The visible superficial changes usually show whether the joint is or has been diseased, but alone are not proof that the existent lameness is due to spavin, for very frequently the lameness disappears after ankylosis of the joint, though other conditions may interfere with the movement of the limb. To refer such lameness to the changes in the hock-joint would be a serious error.

The diagnosis "spavin lameness" is justified when:—

(1) The local changes are accompanied by lameness, the course and other peculiarities of which agree with the description above given.

(2) Muscular atrophy or other condition points to old-standing lameness, probably connected with the anatomical changes. As already stated, exostoses are more likely to cause lameness the nearer they lie to the front of the joint. Sometimes traces of past treatment are visible, pointing to a chronic condition, and supporting the diagnosis "spavin."

Acute inflammatory symptoms, increased warmth, pain on pressure, &c., are seldom met with unless the condition has resulted from violence, but their presence is not incompatible with spavin lameness.

Differential diagnosis. By bearing in mind the above-mentioned principles, mistakes will usually be avoided, though the following conditions should be considered:—

(1) Stringhalt, a disease which will be described in another place.

Here it need only be remarked that the periodical appearance and gradual abatement of lameness during work point to spavin.

(2) Hip lameness. In these cases lameness is only marked when the limb is carried (swinging leg lameness), whilst in spavin it exists both when the limb is carried and when weight is placed on it. The same applies to—

(3) Gonitis chronica, in which also there is a marked tendency to stand with the limb flexed.

(4) Inflammation of the tendon sheath of the flexor pedis at the inner side of the hock-joint. This, however, can scarcely be mistaken for spavin, on account of the marked swelling.

(5) Tendinitis and tendovaginitis of the flexors of the foot lead, in the hind limb, to pronounced lameness when weight is thrown on the limb (supporting leg lameness), and can be detected by careful palpation.

(6) Curb is less likely to be mistaken for spavin, because it seldom produces marked lameness, unless when accompanying the latter.

(7) Spavin lameness is more difficult to differentiate from that due to ring-bone and sprain of the coronet-joint. It should be remembered, however, that, in a hind limb, ring-bone is less frequently followed by great lameness, whilst sprain is usually distinguished by the pain (due to rotation of the joint) which occurs when the animal is sharply turned round.

(8) The absence of foot lameness is proved by a careful examination of the hoof.

(9) Double-sided spavin is sometimes difficult to distinguish from mere stiffness. In "worn" horses, which, as a rule, show no real lameness, too much importance should not be attached to the results of the spavin test, nor to the stiff movement.

Course and prognosis. The nature of the disease explains its chronic course. It is rarely caused by mechanical violence, but as a rule results from slight, continually repeated strain, and, therefore, develops slowly. The first symptom is usually slight sensitiveness, soon followed by lameness, though at this stage no anatomical change can be detected in the joint. Sometimes, however, disease processes are so gradual that lameness is entirely absent during the first stage, and before it develops, bony growth can be detected on the joint.

Generally, the appearance of the exostosis is preceded by lameness, which gradually increases in severity in proportion as the disease becomes more pronounced. In cases where at first it was only noticeable during the first few steps, it afterwards becomes continuous. Considering the nature of the pathological process, it is scarcely

surprising that lameness appears periodically, is sometimes lost and then returns, or that in certain exceptional cases recovery takes place without treatment of any kind except complete and prolonged rest. From a purely theoretical standpoint there is no reason why the lesions in the joint may not disappear and the parts recover in every respect the *status quo ante*, but, in point of fact, this termination is very rare. As a rule, recovery is only relative, and is followed by obliteration of the affected joints. When the articular surfaces have undergone change and the cartilage is destroyed, repair is absolutely impossible, and recovery can only result from fusion of the opposing diseased articular surfaces. This takes from eight to ten weeks, but may be indefinitely prolonged; sometimes it never occurs, and the lameness is incurable. In actual practice it is never possible to fortell with certainty how the case will terminate, though a careful consideration of all the facts may give some indication.

Though union principally depends on the animal being rested and placed under treatment, failing which the parts seldom unite, and lameness persists, the converse is not equally true, for even the most energetic treatment is not always successful. Resolution, *i.e.*, the disappearance of inflammation and local change, is exceptionally rare.

Errors in diagnosis have led to the belief that absorption often occurs, and that absorptive processes may be assisted by treatment. Möller's experience is quite opposed to this view, which is due to confusing with spavin (*i.e.*, arthritis chronica) many varied disease processes, the sole common feature of which is lameness. It is certainly difficult at times confidently to diagnose spavin on the first examination, especially if no reliable history is available. Nevertheless, an attempt at distinction should always be made, otherwise prognosis and treatment are mere gropings in the dark.

Not infrequently lameness diminishes or disappears after a long rest, but the improvement is only temporary, and as soon as the horse returns to work, lameness recurs in an even severer form. It is clear that, with rest, the inflammation may diminish in intensity, but it seldom disappears completely. Though spavin may be viewed as a typical disease of the hock, yet it shows many variations in course, partly on account of the conformation of the joint, partly of the degree and extent of disease processes, but especially of the variation in external influences, amongst the principal of which must be ranked the treatment employed in the particular case.

In forming a prognosis it is necessary to bear in mind all the factors which favour relative recovery, *i.e.*, which contribute to

removal of lameness, as well as those, on the other hand, which are likely to prevent it. The occurrence of spavin in young animals which have not done much work points to a strong hereditary predisposition, and naturally gives an unfavourable cast to the prognosis. In such animals the lameness may disappear for a time, but returns immediately work is resumed. On the other hand, spavin lameness first developed at an advanced age is not likely to disappear, as reparative processes are then sluggish.

Prognosis, though to some extent guided by the facts given, is always uncertain. It is never possible to say confidently that lameness will disappear, even when the diagnosis is beyond doubt. The varying formation of the hock and of the limb in the different breeds, the uses to which horses are put, and other factors (including errors in diagnosis), lead to the percentage of recoveries being very varyingly estimated by different experts. Taken altogether, they may number about 50 per cent.

As already stated, eight to ten weeks' rest and suitable treatment are generally necessary for the disappearance of lameness. Although recovery is not impossible, even during continued work, yet a great many of such reported cases must be referred to errors in diagnosis.

Treatment. Spavin lameness is seldom followed by spontaneous recovery, and the first essential of treatment is sufficiently prolonged rest. Havemann, Strauss, and others consider all treatment useless, but this is certainly too extreme a view, for every busy practitioner must know of many horses which, after treatment, have perfectly recovered their usefulness. The nature of the pathological changes renders cure only relative, for the articular surfaces never recover their normal condition, and well-developed spavin lameness only disappears after ankylosis of the joint. Very often the lower joints of one or other, not infrequently of both, hocks are found completely ankylosed in animals which trotted perfectly sound before death. Practically speaking, all modes of treatment aim at producing union of the affected bones.

This union requires, firstly, prolonged and perfect rest, *i.e.*, stoppage of all work, and, as far as possible, of movement. Whatever the nature of the other treatment, rest is essential, and must be continued for eight to ten weeks.

Various auxiliary measures of treatment have been proposed and employed, but they all agree, on the one hand, in procuring rest of the joint, and, on the other, in evoking, in the neighbourhood of the diseased part, an acute inflammation, which favours adhesion of the bones. Ankylosis may be assisted by—(1) Blisters. The

effect of blisters is usually too superficial. To exert much influence on adhesive processes, energetic, deep-seated inflammation must be excited, and sublimate solution, arsenic, croton oil, &c., are therefore more successful than cantharides blisters, though they are very liable to produce permanent blemishes; good results following the application of cantharides are usually due either to the rest given, or to the case not being spavin. The success obtained in the army by blisters may be similarly explained. To satisfy the owner Möller has often tried blisters, but seldom with good results. They may possibly be more active when subcutaneously employed, as recommended by Buch and Bassi. Bassi makes two or three converging incisions through the skin at the diseased spot, loosens the subcutis, and fills the pockets thus formed with blister.

Setons, formerly much used, are now seldom employed. They are easily rubbed out by the opposite foot, and may leave conspicuous scars.

(2) The actual cautery. On account of the more intense and penetrating inflammation produced, firing is more effective than blistering, and (*ceteris paribus*) in direct proportion to the intensity and extent of the irritation which it excites. It is of little importance whether the firing be in lines or points; the great thing is to set up artificial inflammation in the depths. Many practitioners, therefore, prefer to perforate the skin with a pear-shaped iron; in France a long point is preferred. In Germany, Gerlach tried the latter and other methods, but renounced them on account of the risk of producing fatal arthritis. Perforation of the skin and of the bursa of the flexor metatarsi with the pyriform iron is usually harmless, and is unquestionably amongst the most effective methods of dealing with spavin. The point used in France is from $\frac{3}{8}$ to $\frac{5}{8}$ of an inch long, and therefore seldom penetrates the joint, but when there is no marked exostosis, such an accident is quite possible. In presence of a large spavin, perforation is scarcely ever followed by bad results. If the deposit be slight, the red-hot iron should be applied once to the highest point of the swelling, and passed through the skin into the bone by firm pressure. In dealing with large spavins, this may be done at two or even three points. As a rule, a blister of sublimate (1 to 6) may at once be applied. Sometimes the tendon sheath of the flexor metatarsi becomes acutely inflamed, and severe lameness lasting several days results. This need cause no alarm, for the inflammation will pass away of itself. When the exostosis is small, the use of the pointed iron is somewhat dangerous.

The pointed cautery is unquestionably the best means of dealing

with spavin. Dollar disinfests the parts and uses the platinum-pointed cautery, applying a surgical dressing immediately afterwards, instead of blistering; or, preferably, saturating the parts several times daily with 5 per cent. creolin solution. Hoffmann uses knitting-needles held in a pair of forceps, and introduced glowing hot. The animal is cast, the point of operation disinfected and rubbed with an antiseptic powder. The necessary number of knitting-needles (which can be broken in two) are placed in a basketful of burning charcoal, and, as required, are grasped with forceps and introduced into the bone. From fifteen to twenty perforations are made over a surface as large as a small lemon. They enter the bone deeply enough to reach the cancellous tissue. If want of resistance to the introduction of the needle shows that the joint has been entered, the needle must then at once be withdrawn.

After firing, Hoffmann applies a thick coating of iodoform, lays the hand flat on the parts, and moves the skin backward and forward so as to displace the openings in the skin from those in the deeper-seated structures. The surfaces are then once more strewn with iodoform. After some days a slight swelling occurs, an eschar forms, and in fourteen days all symptoms are stated to disappear.

Batazzi recently recommended the treatment of spavin by subcutaneous firing, formerly introduced by Nanzio. After making an incision $1\frac{1}{2}$ to 2 inches in length over the exostosis, the edges of the wound are drawn back and a few punctures made in the form of a triangle, with the base directed upwards. The same effect is more simply produced by firing through the skin, which has the advantage of producing smaller cicatrices.

(3) Operation for spavin. Since the times of Abildgaard and Lafosse many operations have been proposed for the cure of spavin. Abildgaard first described section of the cunean tendon of the flexor metatarsi, afterwards extensively practised by Lafosse. Dieckerhoff suggested opening the bursa of this tendon. No doubt these operative measures may assist in removing lameness, but their usefulness

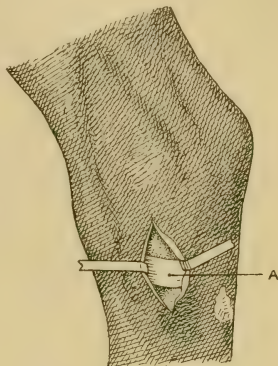


FIG. 536.—Operation for division of the cunean tendon of the flexor metatarsi muscle. A, The tendon.

probably depends on the acute inflammation which follows assisting union of the diseased surfaces, and not, as Abildgaard and Lafosse thought, on their producing relaxation of the tendon, and preventing it pressing on the diseased joint. Division of the tendon is, therefore, of much less importance than the production of an acute inflammation of the bursa, which extends to neighbouring structures. Dieckerhoff's method is very simple, and quiet horses may be operated on standing. Restive or dangerous animals are cast, with the affected limb lowermost. A twitch is applied, the horse is placed against the wall with the sound limb lifted as in shoeing, and the operator then passes a probe-pointed bistoury into the bursa of the diseased limb. After making sure that the bursa is really opened, the animal is placed in the stable. No after-treatment seems necessary, except to remove excessive granulations by suitable caustics. The wound generally cicatrises in three weeks, and after a further interval of a fortnight the horse can be put to work.

In many cases this method is successful, but in others recovery does not occur, while in a certain, though small, proportion acute inflammation of a joint develops, and proves fatal. If in making the incision the operator cut too deeply, which is sometimes unavoidable, and alight on the boundary between the scaphoid and cuneiform bones, the joint is opened, and purulent arthritis readily follows. It is, therefore, well not to make the incision too far back. Dieckerhoff recommends the centre point between the anterior and posterior borders of the hock.

The bursa can also be opened with a rather sharply-pointed pyriform cautery. It seems of no importance which method is adopted, though in using the firing-iron care must be taken not to open a joint. The larger the exostosis, the less the danger.

By bearing in mind that union depends chiefly on the formation of exostoses around the joint, and that the articular surfaces themselves can only grow together after extensive destruction of the articular cartilage, the reason for seeking to produce extensive bony deposit will be apparent.

Periosteotomy is the surest method of effecting this, and has been widely recommended in the treatment of spavin. The operations recommended do not differ in any essential point. Peters' method gives excellent results:—The horse is cast on the diseased side, and by a cord passed round the corresponding front limb, the upper hind leg is drawn far enough forward to clear the seat of operation. The hair is then cut away from the inner surface of the hock-joint, midway between its anterior and posterior borders, to the extent of about

one square inch, the surface washed with soap, rinsed with sublimate or carbolic solution, and the other antiseptic precautions, such as cleansing the hands, placing the instruments in carbolic solution, &c., complied with. By means of a probe-pointed bistoury or scalpel, an incision, at right angles to the long axis of the limb, and about half an inch in length, is then made through the skin and fascia at the disinfected spot, a pair of curved scissors are introduced through the opening as far as the joint between the blades, and the skin divided from underlying tissues in the form of a "V," the instrument being first thrust forward, then backward, severing the subcutis. The slightly-curved knife (Fig. 537, *a*) is next introduced into the front pocket of skin, the cutting edge directed backwards to avoid injuring the vena saphena. As soon as it has entered up to the handle, the cutting edge is directed towards the joint, and the back pressed with the fingers of the left hand, while, by gently rocking the instrument, it is made to penetrate the bones of the joint. The same process is repeated in the posterior pocket of skin, the sharp edge of the knife, however, being directed forwards. After wiping away the small amount of blood which escapes from the wound, the surface is rinsed with a disinfectant, and an antiseptic dressing applied. The bandage should be carried down as far as the fetlock, so as to obtain a firm hold. The horse is then allowed to rise, and is placed in the stable. If, during the next few days, the bandage become soaked with blood, it should be renewed, otherwise it is left in position for six to eight days, when the skin wound will be found to have closed.

By the exercise of moderate care in operating, pus formation can be avoided; and even should it occur, it seldom entails grave consequences, for, on account of the flat position of the knife while making the incision, there is a little danger of opening the joint, and thus producing arthritis.

The horse must be rested for at least four to six weeks after operation, and during this time movement, as far as possible, avoided. Some operators even recommend fastening the animal up short to prevent it lying down.

Möller discovered by experiment that both the inner tendon of the flexor metatarsi and the periosteum of the cuneiform bones

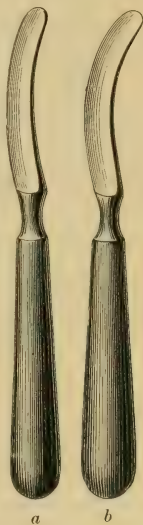


FIG. 537 — Periosteotomy knives.

those that were traced, many had remained for years free from lameness.

Klemm's method of dividing the flexor metatarsi muscle 3 or 4 inches above the hock-joint is, in Möller's experience, useless. If divided completely, lameness follows similar to that after rupture of the tendon (see "Rupture of the Flexor Metatarsi"). By giving four to six weeks' rest, the joint may become ankylosed, and lameness disappear, but this often fails to occur. Partial section sometimes disguises the stringhalt-like lameness, but cannot cure the disease of the joint, and the owner generally returns after an interval to submit the horse to further treatment.

In the Prussian army the actual cautery has, during the last few years, been largely used in treating spavin, the successes numbering about 60 per cent. The method recommended consists in perforating the bursa with a pyriform iron, which is passed into the bone. Periosteotomy proved of less value. It must, however, be remembered that in no other disease are diagnostic errors so frequent as here, for even the most careful examination often leads to no definite conclusion. Serious methods of treatment are only applied to serious conditions, *i.e.*, to cases in which disease has made extensive progress, whilst the milder cases are blistered or fired; especially in the army where firing and blistering are greatly relied on.

In a number of cases where the spavin is old, large, diffuse, and especially when it extends far forwards towards the bend of the hock, firing, even if repeated, and section of the cunean branch of the flexor metatarsi tendon fail, or only yield a very modified success; lameness persists or is remittent, being less marked after a certain amount of exercise than on leaving the stable, though sometimes it is equally pronounced before and after exercise: in these rebellious cases double neurectomy of the posterior and anterior tibial nerves, the latter a branch of the external popliteal, has been recommended. This treatment of obstinate spavin by neurectomy is based on the

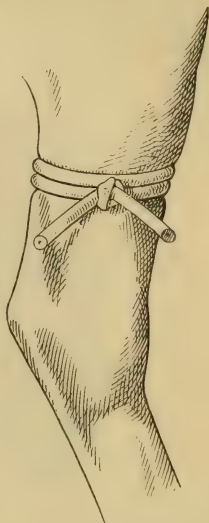
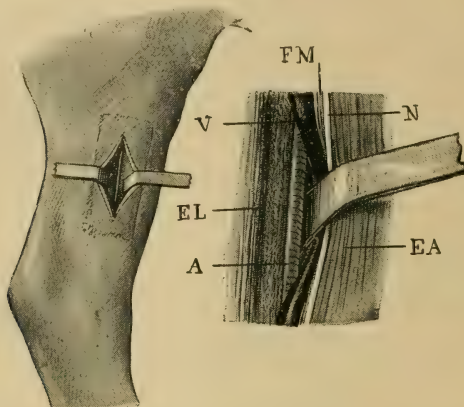


FIG. 539.—Rubber cord applied to thigh to check bleeding. In neurectomy of the posterior tibial nerve the cord would be applied rather higher.

following anatomical facts :—Opposite the point of the calcis the posterior tibial nerve divides into two parts, the internal and external plantar nerves. Behind the hock-joint the external plantar nerve gives off a fairly large branch, which passes under the tendon of the flexor perforans, and detaches several twigs, of which some ramify over the surface of the joint, whilst others penetrate into it. In front of the lower extremity of the tibia the tibial nerve gives off several branches, which enter the joint.

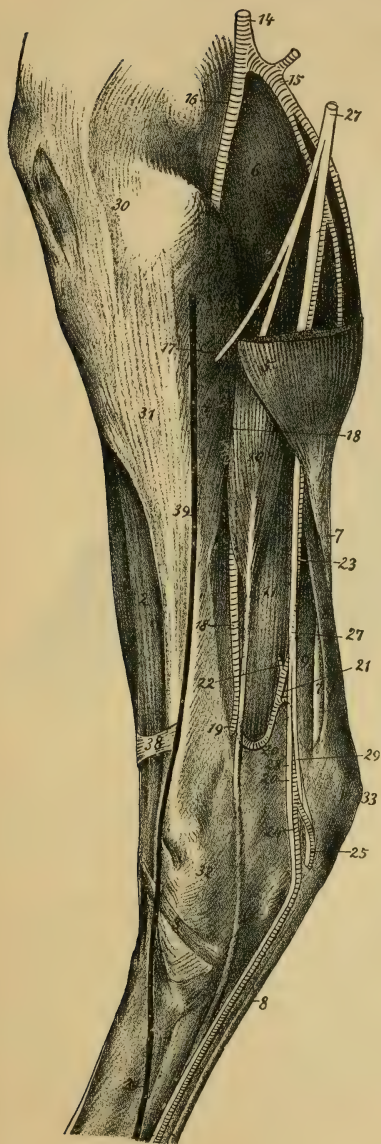
In neurectomy of the anterior tibial, the point selected is at the external surface of the lower part of the leg, a hand's breadth above



FIGS. 540 AND 541.—Neurectomy of the anterior tibial nerve. E A, Extensor pedis muscle; E L, tendinous portion of flexor metatarsi; F M, muscular portion of flexor metatarsi; N, anterior tibial nerve; V, anterior tibial vein; A, anterior tibial artery. (The operation should be performed a little nearer the hock than indicated on Fig. 540.)

the point of the hock. The anterior tibial nerve is situated on the deep surface of the extensor pedis, between this muscle and the thin muscular portion of the flexor metatarsi which separates it from the anterior tibial artery, and from its large satellite vein—vessels which lie directly on the anterior surface of the tibia, where they are surrounded by a thick layer of connective tissue (see section, Fig. 538).

The method is as follows :—The point of operation being prepared, the skin and subjacent aponeurosis are incised for a distance of $2\frac{1}{2}$ to 3 inches, opposite the external margin of the extensor pedis muscle. This muscle is separated first from the tendinous, then from the muscular portion of the flexor metatarsi, on the anterior surface of



1. Extensor pedis muscle.
2. Muscular portion of the flexor metatarsi.
3. Internal terminal tendon of flexor metatarsi.
4. Popliteus muscle.
5. Inner head of gastrocnemius.
6. Outer head of gastrocnemius.
7. Tendo Achillis.
8. Tendon of flexor perforatus muscle.
9. Reinforcing band of flexor tendons.
10. Flexor accessorius muscle.
11. Flexor perforans muscle.
14. Femoral artery.
15. Femoro-popliteal artery.
16. Popliteal artery.
17. Anterior tibial artery.
18. Posterior tibial artery.
- 19, 20, and 21. Its S-shaped curve.
- 22 and 23. Anastomosing twigs.
- 24 and 25. Internal and external plantar arteries.
27. Internal popliteal nerve (continued lower towards the hock as the posterior tibial nerve).
- 28 and 29. Internal and external plantar nerves.
30. Stifle-joint.
31. Tibia.
32. Hock.
33. Point of hock.
38. Annular band of hock.
39. Saphenous vein.

FIG. 542.

which the tibial nerve is readily discovered. A fragment of this, $\frac{3}{4}$ of an inch to $1\frac{1}{4}$ inch in length, is excised. The wound is closed by a few cutaneous sutures, with or without providing for drainage. The operation is easy. It is, however, always necessary to proceed methodically and to take care not to injure the tibial vein.

Neurectomy of the posterior tibial nerve is performed as follows:—

The nerve is discovered on the inner side of the hind limb about 4 inches above the point of the hock, where it passes downward just in front of the Achilles tendon. By grasping the tendon from behind and allowing the soft tissues gradually to slip between the fingers

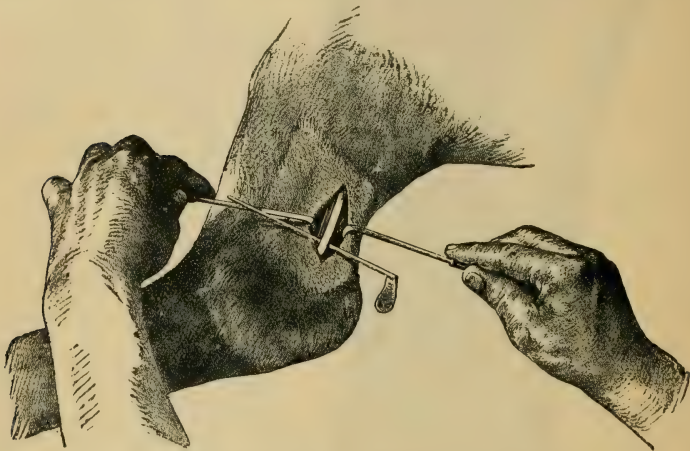


FIG. 543.—Neurectomy of the posterior tibial nerve.

and thumb, the nerve can be felt as a firm cord. At this point it lies about 1 to $1\frac{1}{4}$ inch in front of the Achilles tendon, and rather nearer the inner side of the limb, from which the operation is performed.

The horse is cast with the affected limb undermost, and the upper hind limb is fixed to the upper fore, so as to leave the field of operation clear. To check bleeding a rubber cord may be tightly applied about the middle of the lower thigh. A liberal space around the seat of operation is shaved, washed and disinfected, and about 4 inches above the top of the os calcis and 1 full inch in front of the Achilles tendon an incision 2 to $2\frac{1}{2}$ inches long is made parallel to the tendon. After ligaturing any bleeding vessels, two retractors are introduced into the wound and the edges drawn back to allow the subcutaneous

tissue to be divided down to the underlying fascia. After again ascertaining by palpation the exact position of the nerve the fascia is divided in the same direction and to the same extent as the skin wound. A fragment of fascia about $\frac{1}{2}$ inch wide may then be removed with scissors, whereupon the nerve, recognisable by its white colour and fibrous consistence, usually projects through the opening. A thread is passed under it with a blunt-pointed needle; and a piece an inch in length is then dissected free, and divided as high up as possible and again at the lower limit of the wound with knife or scissors.

As healing by first intention is rather difficult to attain, sutures are only necessary where rather severe bleeding occurs.

The formation of a neuroma on the central end of the divided nerve is uncommon, and when occurring is usually due to the fact that the end of the nerve has been left too long, so that it projects into the operation wound. Should it occur, however, it may necessitate a second operation for its removal, and in this event it is usually best to operate at a higher point, as the formation of fibrous tissue usually renders it difficult to find the divided end.

Double neurectomy of the anterior and posterior tibial nerves is not without danger, trophic changes in the foot, local sloughing, and loss of the hoof often occurring. The operation has nevertheless proved successful when all other methods have failed. Bosi, who introduced it, has had a number of very favourable results, as have Fröhner and Schimmel. Necessarily it does not modify the changes in the joint, though it may remove the lameness.

The shoeing is of some importance. Klemm recommends raising the heels, and giving long quarters and a short toe, a suggestion supported by experience. Köster also recommended shortening the toe of the foot before treatment, and using long, wide shoes, with heels and toe-pieces.

VI.—ENLARGEMENTS ON THE OUTER SURFACE OF THE HOCK.

THE above title includes all circumscribed thickenings on the outside of the hock-joint. They may be situated in the ligamentous apparatus, particularly in the outer lateral ligament, or may arise from the cuboid, outer small metatarsal or other bone of the hock, but seldom from a joint. Careful examination shows the nature of the condition, which usually results from kicks or other injuries of the outer surface of the hock. Sometimes it accompanies spavin,

or forms a complication of that disease, in consequence of the chronic arthritis extending to the outer surface of the joint.

It not infrequently happens that the head of the outer small metatarsal bone is abnormally prominent, or is rendered so by the development of an enlargement. It then forms a projection beyond the general vertical line of the hock, best seen when the joint is viewed from behind. This is the condition known in France as "*jarde*." Gillet, Sipierre, Goubaux and Barrier, all of whom studied the condition, state that it does not affect the hock-joint, but is invariably confined to the head of the small metatarsal and the ligament connecting the latter with the large metatarsal. Other authors, however, believe that it may extend to the hock-joint and produce on the outer surface a condition similar to spavin.

Hertwig insisted that horses often go lame from this condition, and show jerking movements of the limb similar to those seen in spavin. Möller has only seen lameness where the enlargement was accompanied by spavin. As a rule, when lameness is present there is acute inflammation of the outer lateral ligament or of the periosteum.

Diagnosis. The examination for this enlargement is similar to that for spavin. The outer surfaces of the hocks should be compared. As a rule, it is easy to discover whether the skin alone is thickened, or whether the deeper-lying structures are involved.

The prognosis is usually favourable. Only when spavin is also present is the prognosis doubtful.

Treatment is usually unnecessary. If the ligaments and periosteum are acutely inflamed, they should be treated accordingly. In most cases rest and blistering remove the lameness, though thickening seldom disappears, and a slight blemish may always remain.

VII.—CURB.

WITH horsemen, the name curb is applied to all swellings on the posterior surface of the hock-joint. Seen from one side, the back of the hock-joint should appear as an absolutely straight line, stretching from the tuber calcanei to the fetlock. About 3—4 inches below the point of the calcis a swelling or convexity sometimes appears. (The French "*courbe*" is not identical with the English "*curb*." It represents a bony enlargement on the inner surface of the lower extremity of the tibia.)

In or about the posterior region of the hock, in certain cases, enlargements occur and are due to abnormal development of the head

of the small external metatarsal bone, to thickening of the skin, annular ligament, or perforatus tendon, or to distension of the tarsal sheath of the perforans, which lies at the inner side of the posterior border of the hock. These conditions, which are usually easy of recognition, though sometimes erroneously described as curbs, must, however, be distinguished from thickening of the calcaneo-metatarsal ligament or true curb. The upper end of this ligament is attached to the posterior border of the tuber calcis, whence it passes downwards to become inserted on the cuboid, and the head of the external small metatarsal bone. In consequence of sprain, it often becomes inflamed and thickened, or the inflammation may possibly induce changes in the adjacent joint. Distension of the tarsal sheath, or thickening of the perforans tendon, is usually easy to differentiate from curb, inasmuch as the distension or tendinous swelling lies to the inner side of the seat of curb and extends further downwards on the leg. Strain of the perforatus tendon at the upper extremity of the shank may cause difficulty in accurate diagnosis, for the tendon lies over the calcaneo-metatarsal ligament, but the superficial position of the thickening in perforatus strain should enable a distinction to be made between it and disease of the ligament or curb.

Causes. The lower portion of the limb, from the point of the os calcis to the ground, may be regarded as a long lever. The pull of the gastrocnemius muscle acting on the point of the calcis tends to break this lever in two across the fulcrum, represented by the lower end of the tibia. The tissue which resists the breaking strain and holds the os calcis in line with the other bones of the limb is the calcaneo-metatarsal ligament. It is easy, then, to estimate the great strains to which this ligament is subject, and to understand why it frequently becomes injured. Horses with "tied-in" and "sickle-shaped" hocks are especially predisposed to curb, and, if incautiously worked before maturity, generally develop it. The reason appears to be that, as the ligament serves to unite the metatarsus to the os calcis, and as the calcis acts like a lever, to the end of which are attached the extensor tendons, especially the tendon of the gastrocnemius, the more nearly the bend of the hock approaches



FIG. 544.—Curb.

a right angle, the more powerfully does the gastrocnemius act, and, consequently, the more likely is this ligament to become strained.

In "tied-in" hocks the lower row of bones and the upper end of the metatarsus are too slight; the distance between the calcaneo-metatarsal ligament and the anterior margin of the hock, which represents another lever, is too short. The less this distance, the more liable is the ligament to be strained and inflamed when the limb is forcibly extended during movement.

The exciting causes consist in severe exertion, violent attempts at extension at moments when the limb is flexed and sustaining weight, as in jumping, or in heavy or uphill draught-work. Curb sometimes results from the horse being suddenly thrown on its haunches. The more powerful the muscles of the quarter and limb, the greater the strain on the ligament, a fact which explains the frequency of curb in very powerful horses.

Symptoms. Change in the form of the joint. Curb appears as a swelling in the otherwise straight line of the hock when seen from the side (Fig. 544). Careful examination and palpation differentiate strain of the calcaneo-metatarsal ligament from disease of the tendon, tendon sheath, or skin, or enlargement of the head of the external small metatarsal bone. Lameness is seldom well marked in curb, which, in many horses, may form little more than a blemish. When occurring, lameness is due either to co-existing disease, or to inflammation arising from strain or partial rupture of the calcaneo-metatarsal ligament. Curb, when slowly developed, may not interfere with movement, but when caused by violent injury with rupture of the ligament is often accompanied by sudden and severe lameness, which, however, in most cases rapidly diminishes. In side movement, pain is shown when weight is thrown on the limb, the fetlock is flexed, and the horse steps over on the toe; at rest, the heel is raised. In such cases pain and increased warmth may be detected on pressure over the affected spot. These symptoms generally disappear in from one to three weeks, but the swelling persists. Young horses in regular work are liable to suffer from relapse.

Prognosis. The gravity of curb varies greatly. In general, and particularly in old working-horses, it is simply a blemish, but animals exhibiting large or diffused curb should not be used for breeding, especially if the formation of the hock-joint be defective. In young animals, and in cases accompanied by chronic or intermittent lameness, prognosis depends partly on the extent to which the animal's usefulness is affected, partly on the formation of the

hock-joint and the work to be done. Animals with weak "tied-in" hock joints, if put to regular work, are lame repeatedly, and may become nearly useless.

The treatment varies with the nature of the condition. In acute inflammation, with marked lameness, refrigerants, &c., with iodine ointment and massage, are indicated. Blisters and the actual cautery are often necessary, after the acute symptoms have subsided, to enable the affected limb to stand severe exertion or fast work. The animals must be rested as long as they show lameness. For many cases a few days' rest and the application of a calked shoe may be sufficient to enable the horse to resume work. Local treatment can never completely remove old curbs, but for chronic swellings with intermittent lameness, firing and blistering constitute the best remedy.

VIII.—CAPPED HOCK.

LIKE curb, the term "capped hock" is collective, and includes all swellings on the point of the hock, whatever their cause. Below the skin covering the tuber calcanei in the horse is usually to be found a mucous bursa, lying on the upper or posterior surface of the tendon of the flexor pedis perforatus; under this, again, is a serous bursa for the tendon, which glides over the summit of the os calcis (Fig. 547, *e*).

Capped hock may, therefore, be due to (1) Inflammation or chronic thickening in the cutis or subcutis. (2) Hydrops of the bursa subcutanea; this is one of the commonest causes of capped hock. (3) Swelling originating in the expansion of the flexor pedis perforatus tendon where the latter covers the point of the hock, forming a cap. (4) Hydrops of the serous bursa of this tendon.

Causes. Capped hock results from external injuries produced by kicks or striking against hard objects, from slips, violent exertion, and occasionally as a sequel to purpura hæmorrhagica. Confirmed kickers and irritable mares often have both hocks capped—an indication which it is well to note when handling such animals. Horses addicted to standing with the hind legs against the wall of the loose box sometimes show this defect on one or both hocks. Horses often strike themselves against the side of the truck or vessel when travelling by rail or water, and produce capped hock.

Symptoms. Though the swelling is recognised at a glance, especially if the hock be seen from the side, yet careful examination and palpation are required to determine the exact cause to which it is due. (Edema and inflammation of the skin are easily detected.

Hygroma of the bursa subcutanea has an elastic character, and the swelling lies just under the skin, while hydrops of the tendon sheath is deeper seated, and is covered by the flexor pedis perforatus. Swelling of the tendon itself is characterised by greater hardness—a feature still more marked in exostosis on the tuber calcanei.

In acute inflammation, increased warmth and pain can be detected. Purulent cellulitis and disease of the bursa subcutanea may lead to well-marked and widely-distributed swelling; the tumour on the

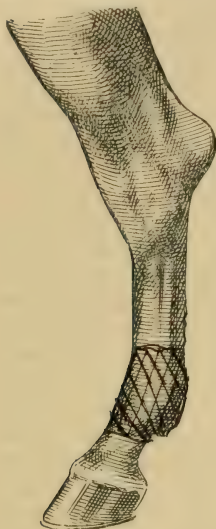


FIG. 545. — Capped hock (dropsy of the subcutaneous bursa of the hock).

point of the hock is then rounded in shape, and may attain a large size. In aseptic inflammation, on the contrary, swelling is confined to the seat of injury.

Lameness is rarely marked, and never occurs in simple injury of the skin or mucous bursa. Even when purulent inflammation sets in, it seldom produces lameness. On the other hand, inflammation of the flexor pedis perforatus, of its bursa, or of the tuberosity of the os calcis, may produce great difficulty in movement; infective conditions in these structures are generally accompanied by severe lameness; but in all aseptic processes lameness is absent, or only occurs during development.

Prognosis. Serous capped hock can seldom be cured, though the removal of cutaneous thickening is less difficult. Hygroma of the bursa subcutanea is usually obstinate, but can sometimes be improved, or even completely cured.

Disease of the flexor pedis perforatus or of its bursa is always more serious, and generally incurable, as is thickening of the os calcis, though recent cases sometimes improve under proper treatment. As mucous or subcutaneous capped hock seldom produces lameness, the working powers are not much interfered with. Even in draught-horses it is far less grave than curb.

Treatment. As a preventive the sides of the stall should be padded, and the animal, if inclined to kick at night, should be hobbled. Hock boots may be worn. Where acute inflammation exists, cold applications are indicated, as in curb. Wounds must be carefully disinfected. In disease of the skin and mucous bursa, resolvent applications and massage are most useful.

Recent cases of hydrops in the subcutaneous bursa, or perforatus bursa, should be treated by blistering, by the compound cantharides and euphorbium plaster, or by cantharides-collodion. The last two form a firm, unyielding covering on the surface of the skin, which exerts continuous pressure on the inflamed swelling, and assists resorption of fluid from the bursa. Cantharides-collodion is even more convenient than the plaster, though it must be repeatedly applied at short intervals, and the neighbourhood of the swelling covered so as to produce a sufficiently firm covering. Moderately active preparations are preferable to severe blisters. Exercise is very useful, except during the inflammatory stages.

Practitioners differ as to the advisability of surgical interference, mainly because the various forms of capped hock are not always differentiated.

Puncture of the swelling with the hollow needle or slender trocar is seldom of service, the contents being soon replaced. It might perhaps be advantageously supplemented by the use of plaster or collodion, applied immediately after operation.

In capped hock the knife has been employed with very varying success. Laying open the distended bursa subcutanea is seldom dangerous, and sometimes removes the hygroma; but the result is not certain, and depends principally on the degree of inflammation excited. Lanzillotti-Buonsanti operated successfully in two cases of distension of the subcutaneous bursa. Proceeding with strict antiseptic precautions he made a half-moon-shaped incision on the outer surface of the swelling, and through it he enucleated the wall of the bursa. Sutures were inserted after the horse had risen, and a drainage-tube was introduced in the lower angle of the wound. A dressing was not applied. Healing occurred by primary intention. Opening of the bursa tendinea, however, is not advisable, and in incising the bursa subcutanea care must be taken not to injure the flexor pedis perforatus. The doubtful success which has attended operation for capped hock is principally to be referred to the tendon sheath having been opened. It is better to confine treatment to external applications.

Corps-Rossartz Hell ruptures hygromata (distensions of the subcutaneous bursa) of the point of the hock by violence. For this purpose a bandage is passed round the hock whilst the animal stands on the limb, the other hind foot being lifted up. If the foot be then released, the horse makes such violent attempts to flex the bandaged limb that the bursa may be ruptured subcutaneously, and its contents dispersed. The swelling does not return. One or two

cases have been reported of this method being successfully employed. It appears by no means impracticable. In men, hygroma has for a long time been treated on the same principle.

Wounds of the point of the hock may here receive consideration, as they are often of importance in the treatment of capped hock. Infectious processes in the skin and subcutaneous bursa almost always take a favourable course, and, though liable to be followed by some thickening, do not cause further trouble, even when the swelling is of considerable size. The same is true of wounds. It is quite otherwise in injuries of the serous bursa or the tendon of the flexor pedis perforatus, and suppuration or septic infection at this point is highly dangerous. Marked pain soon sets in, causing the leg to be continuously rested, and movement, as far as possible, avoided. The swelling extends above the hock towards the tibia, fever sets in, laminitis may attack the other foot, in consequence of the continued weight on it, and the animal prove unable to stand. It then lies continuously, and, if not destroyed, may die from the effects (decubitus).

Post-mortem examination shows the cartilaginous covering of the tuber calcanei to be partly or entirely eroded and the flexor pedis perforatus cap more or less abraded. The severe pain and dangerous character of the disease are essentially due to movement of the tendon over the surface of the tuber calcanei, now denuded of cartilage.

Any injury of the perforatus tendon, or even of its bursa, may provoke such results, and it is therefore scarcely needful to say that in recent wounds every effort must be made to prevent infection.

IX.—LUXATION OF THE FLEXOR PEDIS PERFORATUS TENDON.

THE flexor pedis perforatus tendon, at the spot where it plays over the point of the hock, is expanded into a kind of cap. A short but powerful prolongation of the tendon is inserted into the os calcis on either side, just in front of the point of insertion of the tendo Achillis, which prevents the tendon slipping off the summit of the os calcis. Sometimes one of these ligaments is ruptured, allowing the tendon to glide off the calcis towards the opposite side, and to lie towards the lateral surface of the hock. Günther describes a case of dislocation towards the inner side; others have seen it occur outwards. The direction depends, of course, on which attachment is ruptured. As the tendon passes over the hock from within outwards, one would expect that the external attachment would most frequently suffer, and that dislocation would be towards the inner side. On

the inner side the tendon either remains fixed about half-way up the astragalus, or slips down as far as the articular prominence of that bone.

Such ruptures occur in falling when jumping, violent kicking, or follow external injuries like contusion, &c.

Symptoms. Displacement is rarely followed by severe lameness; the gait is insecure, awkward and rolling, and the animal appears to have lost full control of the limb. Standing behind the horse, the perforatus tendon is seen to deviate to one side of the os calcis every time the hock is extended. In other cases the tendon, though displaced, can easily be returned to its position on the point of the calcis; but almost immediately becomes again luxated. When the tendon and neighbouring parts are inflamed from kicks, &c., the swelling and pain produce a more marked lameness, otherwise movement is only mechanically interfered with.

Prognosis. Recovery is uncertain on account of the difficulty of fixing the hock for a sufficient length of time to allow the ends of the ruptured ligament to unite. Even though the tendon can be replaced, it tends to slip out of position the next time the limb is extended or weight is placed on it. As a rule, outward luxation is much more hopeful than inward displacement of the tendon. Usually the animals recover sufficiently to do light work, and those with outward luxation may become serviceable for fast work.

Treatment consists in resting the horse and checking the local inflammation sometimes seen in recent cases. After an interval, the hock may be blistered once or twice. Drouet and others suggest suturing the tendon to the tendo Achillis and calcaneo-metatarsal ligament. Sometimes the luxated tendon can be secured in position by silver wire sutures passed through the os calcis. The sutures are inserted in the recumbent position and afterwards tied when the horse is standing in slings.

X.—STRINGHALT.

THE term "stringhalt" has been applied to that peculiar involuntary movement of one or both hind limbs, in which the affected member is flexed with excessive suddenness, and lifted abnormally high, whilst it still continues able to support the animal, and otherwise allows of movement in the usual way. Similar movements in the fore limbs are rare, but Frick states having seen two cases where they occurred. Sometimes the peculiar movement is seen while trotting, sometimes also while walking; as a rule, it persists

in spite of work ; sometimes it disappears for a time, but generally returns with rest ; often it is only noticeable when the animal is turned in small circles or moved from side to side.

The immediate cause of this interference with movement has been sought for in different organs, but up to the present has not been identified. Abildgaard considered the condition to be an "affection" of the muscles and nerves of the hind limb. Villate thought it was caused by abnormal development of the spine of the tibia. Sewell and Spooner, when making the post-mortem of a horse affected with stringhalt, found that the point of origin of the great sciatic nerve in the spinal cord was infiltrated with blood, and regarded this as the cause of the disease. Falke identified the condition with sciatica in man. Renner took it to be due to chronic inflammation of the great sciatic nerve, whilst Hochstetter attributed it to straightness of the hocks ; Boccar sought the cause in contraction of the peroneus, after discovering that the condition disappeared on section of its tendon. Foelen and many others agreed with him, and reported favourable results from dividing the tendon. Goubaux, on the other hand, directed attention to the joints, especially to the hip-joint, which in his view became chronically inflamed in stringhalt. K. and F. Günther divided it into the following varieties :—

(1) Spavin-stringhalt, *i.e.* stringhalt caused by spavin. (2) False stringhalt, produced by pain in any region of the limb ; and (3) True or involuntary stringhalt, due to irregularities in the functions of the antagonistic nerves of the lumbar and pelvic plexuses.

The Günthers state having frequently seen hyperæmia of the great sciatic nerve without stringhalt, but add that stringhalt is sometimes accompanied by relaxation in the semi-tendinosus muscle. They first drew attention to the connection between stringhalt and certain surgical diseases—as, for instance, those of the foot.

Dieckerhoff divided the disease into—(1) True idiopathic stringhalt, which he considered due to contraction in the fascia of the thigh. (2) Complicated stringhalt, accompanying spavin, curb, ring-bone, and other diseases. (3) Symptomatic stringhalt, consequent on inflammation in the pedal or other regions of the limb.

Bassi recognised two forms :—(1) True stringhalt, caused by interference with the movement of the patella ; and (2) false stringhalt, caused by a number of other diseases, such as spavin, horn tumour, &c., but principally by contraction of the tensor vaginæ femoris, and extensor pedis tendon. Other forms in horses he considers due to brain disease, resulting from asymmetry of the skull, and in dogs to changes in the spinal cord following distemper.

Möller divides stringhalt into idiopathic and symptomatic forms, and includes in the first those cases due to no visible cause ; and, in the second, those where a cause can be detected.

Whatever be the cause, it is quite certain that the movement is involuntary. It must, therefore, be dependent on some mechanical action, *e.g.*, contraction of the fascia, of the tendons, or of the ligaments, or on reflex action, originating either directly in the spinal cord, or through interference with innervation. Probably both

causes may at times be active, though, as a rule, neither can be clinically identified. Amongst mechanical causes—for we may also term the first variety mechanical—changes in the extensor pedis tendon, the fascia of the thigh, and the patella or its ligaments deserve special attention. Even though Siedamgrotzky's attempt to produce contraction by exposing the peroneus tendon, and thrusting a piece of wood under it, gave negative results, yet numerous experiments show that section of this tendon often removes stringhalt. But the fact that it sometimes fails shows that stringhalt is not due to a single cause. Amongst the others must be included contraction of the fascia of the thigh, referred to by Dieckerhoff, of the tensor vaginæ femoris, much spoken of by Hertwig, and of the inner lateral ligament of the patella, mentioned by Bassi. Möller has had no practical experience of the last, though he has repeatedly seen stringhalt-like movement in horses suffering from habitual upward luxation of the patella, and as in these cases the form of the surface of the trochlea of the femur possibly plays a certain part, it seems possible that division of the inner lateral ligament of the patella might prove of service. Möller several times divided the fascia of the thigh when section of the peroneus tendon had proved insufficient, but rarely saw real improvement. When section of the tendon was unsuccessful, that of the fascia always failed. Sometimes these three structures may be divided without affording relief, in which case the condition is probably reflex, and either resembles chorea minor of man, or is due to disturbance in the co-ordination of movement, *i.e.*, ataxia (see "Paralysis of the Hind Extremities").

The results of peripheral irritation chiefly affect the flexor muscles, because the extensors act principally whilst weight is thrown on the limb, and their contraction is therefore more easily controlled. Possibly the central disturbance manifested by the affection of certain groups of muscles may sometimes be of a secondary character, the peripheral irritation in time causing changes in the central nervous mass. At any rate, temporary disease of parts removed from the centre sometimes produces chronic stringhalt. Thus, after injuries to the foot, such as pricks, treads, or laminitis, wounds of the hock, fractures of the external angle of the ilium, or even after the application of a blister or the actual cautery, one sometimes sees stringhalt, which continues despite removal of the original irritation. Ascheberg saw stringhalt result from tetanus. In such cases one might imagine that the peripheral irritation had produced permanent interference with innervation, and that the oft-quoted dictum of Jordanus Ruffus, "*Cessante causa cessat effectus*," no longer applied. Dollar is of

the opinion that many cases of stringhalt are due, like chorea, to localised sclerosis of the spinal cord.

Temporary stringhalt accompanies various conditions, but especially injuries to the foot; Wittlinger saw it after suppuration in the tendon sheath of the fetlock region.

The course of the disease varies greatly. The symptomatic form occasionally accompanying spavin develops slowly, and may disappear at the same time as the spavin lameness. Stringhalt often develops rapidly after external injury; some cases appear suddenly without visible cause, and are attributed (in Möller's opinion

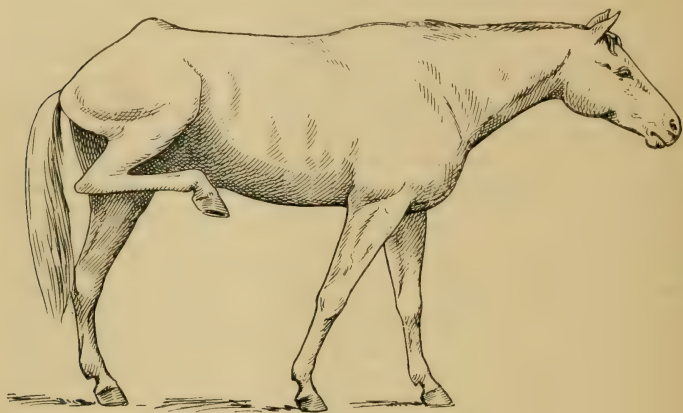


FIG. 546.—Stringhalt.

erroneously) to exposure to cold. Such cases are probably due to muscular rheumatism, which often produces movements resembling stringhalt.

Prognosis is uncertain. The most favourable cases are those of recent origin, or in which the symptoms are intermittent, or have a visible cause; such often cease as soon as the local mischief disappears. In symptomatic stringhalt, the prognosis chiefly depends on the nature of the primary disease, though it should not be forgotten that the interference with movement sometimes becomes permanent. Fortunately stringhalt is more unsightly than harmful. Very rarely does the disease interfere with work. In the absence of apparent cause, prognosis is uncertain, because it is never possible to say whether the methods of treatment at present known may or may not be successful, and treatment, therefore becomes mainly experimental.

Treatment. The operation which has proved most generally successful in idiopathic stringhalt is peroneal tenotomy. It has one qualification—that, namely, of being easily performed. The operation may be performed in the standing position; the procedure is as follows :—

The hind foot is lifted as in shoeing, and the hair having been shaved from an area close below the hock, on the outer surface of the metatarsus, where the peroneus tendon joins the extensor pedis and is almost subcutaneous, the skin is washed and rinsed with carbolic solution. A twitch is then applied, and an incision made with a bistoury or scalpel, immediately over the tendon and parallel to it. To penetrate the fascia lying under the skin, the point of the knife is carried right into the tendon. A slender blunt-pointed tenotome is then passed under the tendon, *i.e.*, between it and the bone, and the cutting edge being directed outwards, the tendon is subcutaneously divided. Excision of a portion of the tendon is of no advantage, and delays healing. Palpation of the parts will show whether section is complete. Bleeding being usually slight, the wound may be rinsed with a disinfectant, sutured, and a dressing at once applied, under which healing will in four to five days be so far advanced as to allow of the wound being left uncovered. If the instruments, operator's hands, and dressings be sterile, early healing results; and even when suppuration occurs, though the point of operation is left somewhat thickened, no further ill-effect is incurred. Complete recovery from stringhalt may follow peroneal tenotomy either at once, or be postponed for some days, or there may be no improvement. Defective extension of the pastern may follow operation and require the application of a sideline to hold the foot in proper position for a few days.

The animal should be rested for eight to fourteen days after operation, and then turned loose in a box, or moved slowly on soft ground.

Möller several times divided the aponeurosis which covers the peroneus and extensor pedis tendons (Dieckerhoff's method) whilst the animal was standing, but restless horses should be cast for either operation. After section of the peroneus, the tenotome is passed under the fascia, which is divided from within outwards, care being taken to avoid wounding the extensor pedis tendon, or artery of the cannon. The after-treatment is as above stated. Practising this method, Wolff has had several successful results.

Hertwig recommended cutting through the tensor vaginae femoris, about 3 or 4 inches below the external angle of the ilium. This operation is more difficult, and is often followed by formation of pus,

asepsis being almost impossible. The result is doubtful; cases are said to have been cured, though in one, which was successful, the incision was only carried through the skin on account of bleeding.

Bassi suggests dividing the internal lateral ligament of the patella. Experiments show that this operation is not easy, on account of the ligament in question being so ill-defined. The method is worth a trial in cases where the cause is thought to lie in the stifle-joint.

Starting from the hypothesis that in one case stringhalt was produced by inflammation of sensory nerves, Möller divided the anterior tibial nerve, but without success. Failure also followed subcutaneous injections of morphine and veratrin, and section of the internal insertion of the flexor metatarsi muscle. Section of the posterior tibial nerve above the hock has succeeded in cases where the cause of the disease was situated in the lower portion of the limb. On an animal affected with bilateral stringhalt, Cadiot successively performed section of the anterior tibial nerve, the peroneus tendon, the plantar nerves and the cord of the flexor metatarsi, without noticeable improvement. In another case he divided the great sciatic nerve at the lower third of the leg; in four days its function was normal, but a month later the hoof sloughed and the patient was destroyed.

A condition in some respects resembling stringhalt has been called "straw cramp." The animals while standing on straw show peculiar symptoms, particularly when turning round. The affected hind limb appears momentarily fixed to the ground, then suddenly lifted as in stringhalt. Painful conditions like inflammation in the skin of the heel or in the bend of the hock produce similar symptoms, which are then, of course, easily explained. But in some horses, particularly in ponies, the attacks occur without any visible cause. The most careful examination fails to detect pain in the affected limb. In such cases tibial neurectomy produces no particular improvement. Similar symptoms are seen in upward luxation of the patella, and in certain debilitating diseases.

In a horse Möller had under observation, a similar effect was produced by irritation of the ear. If the finger were introduced into either ear, the hind limb of the same side was lifted and carried forward in an almost horizontal direction, the movement being convulsive. Though the condition only lasted a few seconds, the horse was quite useless, because the pressure of the bridle or halter on the ear immediately induced fresh attacks. Not the slightest anatomical change could be detected in the ears.

XI.—SHIVERING.

“SHIVERING” is the name applied to a peculiar neuro-muscular disease, characterised by involuntary spasmodic muscular contractions with consequent irregular movements, generally affecting one or both hind-limbs and the tail; sometimes only a fore-limb, or occasionally the limbs, lips, cheeks, eyelids and neck.

Shivering is often regarded as hereditary, but the cause has not been ascertained. Frequently its occurrence is preceded more or less remotely by an attack of strangles, influenza, or pneumonia; and this fact has led many observers to suggest that shivering is connected with neuropathic lesions produced by infection, or toxins derived from antecedent disease. Shivering is sometimes attributed to accidental injuries, falls, fright, &c.

It occurs at all ages, and while principally affecting draught-horses, it is frequently seen in light harness horses, hunters and hacks, and occasionally in thoroughbreds. It is very rare in ponies.

Symptoms and diagnosis. Shivering varies very much in degree or manifestation. The symptoms may be constant and easily seen, or intermittent, occasional or latent and very difficult to discover. Many shivering horses only exhibit the symptoms when being shod, or when moving over in the stall; others while standing in harness constantly attract attention by frequently raising and abducting the shivering hind-limb. In well-marked bilateral posterior shivering, the horse in advancing may give no sign of the disease, or the symptoms may be restricted to the first two or three steps; but on lifting a hind-foot, or in backing the horse, the limb is suddenly raised, semi-flexed and abducted, shaking or shivering in suspension, the superficial muscles of the thigh and quarter quivering, while the tail is elevated and tremulous. In a few moments the spasms cease, the limb is slowly extended and the foot brought to the ground. In severe cases the horse exhibits symptoms on every occasion he is set back, turned round, or moved from side to side. He may be unable to move backwards, or to lie down, and if he should fall, unable to rise without assistance.

Diagnosis of cases in which the symptoms are slight or intermittent usually requires patient observation of the animal in the stable or the forge. Hammering the foot or shoe, allowing the horse to drink from a pail placed on the ground, forcibly backing the horse up hill over rough setts, or slippery pavement, or puncturing the pastern with a pin may reveal the symptoms. Repeated testing of

the horse at longer or shorter intervals, after prolonged exercise or hard work, or watching the horse rising in the early morning, may be necessary before a positive opinion can be formed in a doubtful case.

In anterior shivering, which seldom interferes with the animal's capacity for work, on attempting to lift the foot, the limb is thrust forwards in full extension, the foot barely touching the ground, or the limb with the knee flexed is elevated and abducted, the extensors above the elbow quivering while the spasm lasts or until the foot returns to the ground. When affecting the head, the lips exhibit twitching with spasmodic retraction of the commissure, rapid blinking of the upper eyelid, and sometimes the ear of the same side is in constant motion.

Prognosis. Usually shivering is a chronic or very slowly progressive affection, but it may develop rapidly under constant hard work, or during an attack of intercurrent debilitating disease. This is particularly noticeable in the intermittent and latent forms, when, owing to the excitement of a railway journey, or the pain produced by wounds, injuries to the feet, or arising from colic, influenza, or other systemic disease, the symptoms become much aggravated. Hunting horses that are known to be occasional shiverers, may hunt and jump for several seasons without hindrance or complaint, but eventually they lose power behind, and, though able to gallop and willing to jump, are unable to clear the obstacle with the hind feet, or to rise sufficiently to jump a moderate fence. Rest in the stable or on pasture for six or eight weeks will produce considerable modification in the symptoms of most well-marked cases, and it may enable an affected horse successfully to pass an examination as to soundness. Horses that are slight shiverers, and even those that offer no difficulty in diagnosis, may work satisfactorily for many years, but in time their usefulness becomes greatly impaired; the spasms increase both in frequency and in severity, the hind-quarters become atrophied, and the limbs more or less stiff or rigid. Animals so affected sleep standing, and their fore fetlocks and knees are much bruised and disfigured by frequent half-falls. There is no curative treatment for shivering.

*E. DISEASES OF THE METATARSUS.***I.—DISEASES OF THE TENDONS AND TENDON SHEATHS IN THE TARSAL AND METATARSAL REGIONS.**

IN the horse, the tendon sheaths, both in the hock and metatarsal regions, sometimes become distended, producing conditions of great practical importance. 'Amongst the most important are—

(a) Distension of the synovial sheath, which lines the tarsal arch and covers the flexor pedis perforans, producing two unequal dilatations (tendinous thoroughpin) one on each side in front of the tendo Achillis. Usually the inner swelling is the larger. In some hocks, particularly curbiform and cow-hocks, the same sheath produces inferiorly another dilatation, which follows the course of the flexor tendon to the upper third of the shank.

Disease of this sheath is rather frequent in the horse and occasionally produces a hemispherical swelling as large as a child's head. Sometimes it attacks both legs simultaneously, without causing much lameness (Fig. 551). It may in time decrease and even entirely disappear, especially under proper treatment. In other cases, the inferior portion of the sheath lying towards the back of the hock becomes distended, and may be mistaken for curb, for which reason it has been called curb-gall, or soft curb.

In other cases acute inflammation sets in. Bruises and injuries may cause septic tendo-vaginitis, accompanied by severe lameness and high fever, which sometimes prove very serious. The condition is even more dangerous if inflammation extend to the joint (see "Wounds, &c., of the Hock-joint"), or produce necrosis of the sheath or flexor tendon, followed by rupture.

Tendinous thoroughpin occurs in both old and young horses, and usually arises gradually, without causing any inconvenience. In other cases the swelling appears suddenly, accompanied by lameness, and considerable local pain. It is caused by drawing heavy loads, violent efforts, jumping, throwing the horse on his haunches, rearing, &c. Probably there is a predisposition to distension of this sheath in certain horses.

Prognosis. In many cases the swelling is small and unimportant. It may slowly increase in prominence or it may diminish, especially during winter. Occasionally, owing to injury the local inflammation becomes intense, synovia escapes and the animal, very lame, rests the leg continuously; but so long as the sheath remains aseptic, recovery should be expected. Pyogenic infection of the tarsal sheath

forms no exception to the general rule, and prognosis is therefore unfavourable in all cases of wounding or distension associated with pus formation. Frequently after acute symptoms have disappeared, a

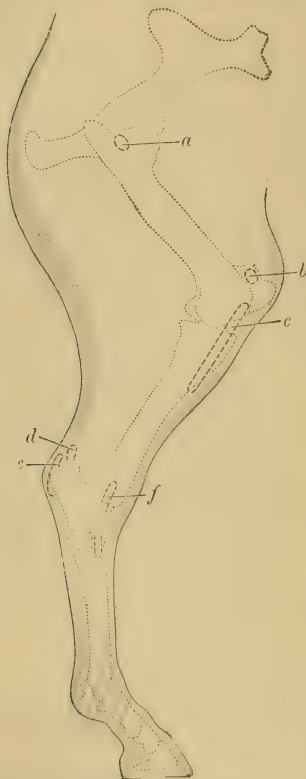


FIG. 547.—Tendon sheaths and bursæ of the hind limb of the horse, seen from without (semi-diagrammatic). *a*, Trochanteric bursa; *b*, prepatellar bursa; *c*, tendon sheath of the extensor pedis; *d*, bursa calcanea; *e*, tendon sheath of the flexor pedis perforatus tendon; *f*, tendon sheath of the peroneus tendon.

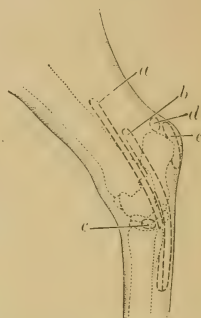


FIG. 548.—Tendon sheaths and bursæ of the hock-joint, seen from within (semi-diagrammatic). *a*, Tendon sheath of the flexor accessorius tendon; *b*, tendon sheath of the flexor pedis perforans tendon; *c*, bursa of the internal division of the flexor metatarsi tendon; *d*, bursa calcanea; *e*, tendon sheath of the flexor pedis perforatus on the point of the hock.

large swelling remains, and its removal by any treatment can scarcely be expected.

Treatment depends on the state of the distension. Wounds near

this tendon sheath, like wounds of the joint, require the strictest antiseptic precautions. In infective inflammation, the tendon sheath may advantageously be washed out with disinfectants.

Acute aseptic inflammation usually calls for nothing more than rest and ordinary soothing treatment; but in cases where this proves insufficient excellent results sometimes follow from freely firing in lines.

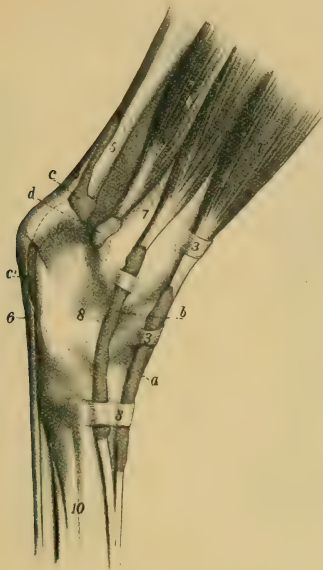


FIG. 549.—External surface of the horse's hock, to show synovial sheaths. *a*, Tendon sheath of the extensor pedis muscle; *b*, tendon sheath of peroneus muscle; *c*, *c'*, tendon sheath of flexor perforatus and gastrocnemius muscles; *d*, protrusion of the synovial capsule of the true hock-joint.

Chronic dropsy of the bursa is also benefited by the cautery. Peuch fires deeply with the pointed iron. Repeated withdrawal of contents, by means of a Pravaz syringe, is sometimes very efficacious. The operation may be repeated every four to six weeks, though careful antisepsis is required to prevent infection of the tendon sheath. For many years French operators have recommended withdrawal of the contents, followed by iodine injections. Cadiot describes the results as excellent. McCall withdraws almost the entire contents

of the distension and then injects a $\frac{1}{2}$ per cent. alcoholic solution of sublimate, to which decolorised tincture of iodine has been added. Frick has several times withdrawn the fluid and then injected a solution containing iodine 2 parts, iodide of potassium 5 parts, and water 100 parts; thereafter he has lightly fired the parts in lines. He states that the results varied, but were never bad.

(b) Distension of the sheath of the extensor pedis tendon in front

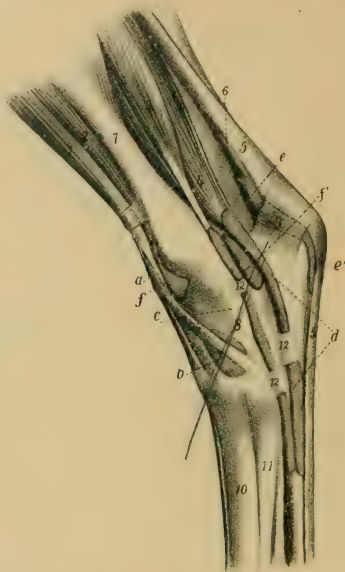


FIG. 550.—Internal surface of the horse's hock to show synovial sheaths. *a*, Tendon sheath of flexor metatarsi muscle; *b*, tendon sheath under inner terminal tendon of flexor metatarsi; *c*, tendon sheath of flexor accessorius; *d*, tendon sheath of flexor perforans; *e*, *e'*, tendon sheath of flexor perforatus and gastrocnemius muscles; *f*, *f'*, distended synovial capsule of the true hock-joint.

of the hock is very rare, while distension of the lateral extensor tendon sheath at the upper extremity of the shank is very common. The tendon of the peroneus muscle is provided, opposite the lower margin of the hock-joint and on its outer aspect, with a small sheath, which, when over-distended, forms an elastic swelling at the upper end of the shank, varying from the size of a walnut to that of a man's fist. The condition is oftenest seen in riding-horses, being caused by slipping or wrenching when the animal is thrown on its haunches; or by

striking the leg against the bale, or heel-post of the stall. As lameness is not a prominent symptom, the swelling is rarely treated, and only forms a blemish.

If necessary, the parts may be blistered and fired in lines. Operation is not dangerous, though, when suppuration occurs, considerable thickening always remains, and the remedy becomes worse than the disease, because everyone knows that the latter is of little importance.

(c) Distension of the sheath of the flexor pedis perforatus. This



FIG. 551.—Distension of bursa of flexor tendon in right hock (from a photograph).



FIG. 552.—Distension of sheath of flexor pedis perforans (from a photograph).

consists in dropsy of the bursa which is interposed between the deep face of the perforatus tendon and the summit of the os calcis and tendo Achillis. In coarse bred horses, it sometimes affects both limbs, and forms above the tuber calcanei an elongated bilateral swelling, extending for 4 or 5 inches along the tendon of the hock. The position and size of the swelling are best recognised by viewing the animal from behind. Sometimes the swelling is more marked on the inner, sometimes on the outer surface of the tendon, which can be distinctly felt in the depths. The swelling generally results from chronic bursitis, develops slowly, and seldom causes lameness.

For this reason **prognosis** is favourable, though the condition itself may prove extremely obstinate. Success sometimes follows repeated evacuation of the contents every three or four weeks. The operation is not without danger, and Möller lost a horse from infective inflammation of the tendon sheath. Line firing may diminish, though it seldom completely removes, the swelling.

(d) The tendon sheaths in the metatarsal and phalangeal regions

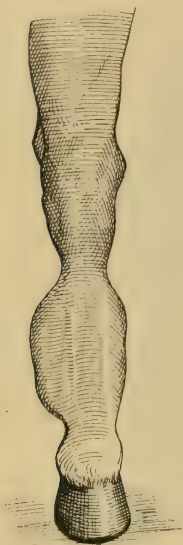


FIG. 553. — Distension of the metatarso-phalangeal (sesamoid) sheath.

become distended in a similar way to those of the fore limb, though the bursa of the extensor pedis, which lies in front of the fetlock-joint, is more often affected than in the fore limb. It gives rise to a well marked, sometimes bilobular swelling, which may attain the size of a child's head, and though it does not always cause lameness, greatly impairs the animal's appearance, and sometimes leads to inflammation of the skin, or even to abscess formation. These swellings usually contain large quantities of fibrinous clot, which, however, cannot be detected by palpation. This explains why, in old-standing cases, neither blistering nor firing, nor even extraction of the fluid contents and injection of iodine solution, is successful, and why operation and removal of the organised contents are alone of use. Such operation is quite safe, even when suppuration occurs. Recovery follows, after strict asepsis, though considerable thickening may be left. When the swelling is extensive, a portion of the distended bursa and skin covering it may be removed, the edges of

the wound brought carefully together, and a compress dressing applied (see also "Treatment of Enlarged Synovial Cavities in the Fore Limb").

Frick saw a peculiar affection of this bursa. The primary swelling and thickening of the walls of the bursa were unaccompanied by pain. Suppuration followed, and a chocolate-coloured, thin, fluid pus, containing white flocculi, was discharged. Slight lameness was then shown (supporting leg lameness), and the granulations which surrounded the wound became rather exuberant. As the wound obstinately refused to heal the horse was killed. On post-mortem examination the bursal cavity was found to communicate with the fetlock-joint. Both contained turbid, chocolate-

coloured fluid. The thickened synovial membrane was covered with granulations, the cartilage of the fetlock-joint showed local ulceration, and the portions of bone thus exposed were granulating. Microscopical examination of the discharges and granulations revealed the presence of tubercle bacilli.

(e) Distension of the sesamoid sheath at the fetlock (tendinous windgall) is commoner in the hind than in the fore limb. As a rule, it is caused by irritation, and forms slowly. Lameness, is seldom troublesome until the flexor tendons are affected; but the swelling forms a blemish difficult to remove. Provided the swelling has not long been in existence, the parts should be tightly bandaged after work; massage often removes the distension in young horses, but firing is more effective. The swelling should never be incised, for the result is often fatal. Removal of contents by a Pravaz syringe, or by trocar, is only of temporary benefit; nor does injection of iodine prevent refilling, which may occur in a few minutes. The precautions to be observed in opening these swellings with the actual cautery are mentioned under "Treatment of Enlarged Synovial Cavities in the Fore Limb."

In the hind limbs such enlargements often become indurated, *i.e.*, the tendon sheath is thickened, sometimes to the extent of $\frac{1}{2}$ or $\frac{3}{4}$ of an inch. As a rule, the flexor tendons are involved, and there is chronic lameness, the horse going on the toe with the heel more or less raised. The swellings are hard and immovable, the flexor tendons can scarcely be felt through them, and when the parts are firmly pressed the animal shows pain.

Such enlargements are most troublesome in riding and draught horses, though, in other animals, they interfere with usefulness and sometimes render the horse unworkable; they are little amenable to treatment. When recent, *i.e.*, not more than a few weeks old, they may be diminished by the use of bandages, blisters, or firing, but later the sole means of removing the lameness is neurectomy of the posterior tibial nerve. Good results often follow this operation, but occasionally the flexor tendons become elongated, producing flexion of the hock and sinking of the fetlock; in a case of Möller's this was so marked as to prevent the animal being used. Hendrickx has had similar results.

As in the fore extremity, dilatations of the synovial membrane of the fetlock joint also occur in the hind-limb, forming swellings (articular windgalls) in front of the suspensory ligament and on the lateral surfaces of the fetlock. At first they are compressible, diminishing at exercise and readily disappearing under bandaging; later, owing to thickening of their walls, they are more resistant,

and compression by bandages fails to remove them. They seldom cause lameness unless injured, as may happen from "cutting or brushing."

II.—SUPPURATIVE INFLAMMATION OF THE SESAMOID SYNOVIAL SHEATH OF THE FLEXOR TENDONS. OPEN SHEATH.

THIS sheath extends from the level of the buttons of the lateral metacarpal bones to the middle of the posterior surface of the os coronæ, where it is separated from the small sesamoid or navicular sheath by an attachment of the perforans tendon. It lines the sesamoid pulley and aponeurosis of the fetlock and is reflected on the flexor tendons.



FIG. 554.—Enlargement of the bursa of the extensor pedis tendon (*i*, in schema of the tendon sheaths of the fore limb, Fig. 471).

Acute infective inflammation of this sheath usually follows mechanical injuries like stabs with stable forks, wounds from harrow-tines, reaper or scythe blades, or contused wounds the result of running away; or infection may arise by extension from suppurating disease of the foot, navicular sheath, coronary abscess, gathered-nail, &c. Chronic purulent inflammation of this sheath may also follow "cutting" or "brushing," and sometimes cases arise unaccountably during an attack of strangles or pneumonia.

The wound, however caused, suppurates and is particularly dangerous, because the tendons are very frequently invaded. The symptoms consist in severe lameness, inability to stand on the limb, and discharge of a purulent synovia from the wound in the tendon sheath. There is usually cellulitis of the surrounding tissues and considerable local swelling and œdema extending up the leg. High fever is not infrequently present, and the animal either stands persistently with the affected limb raised, or lies down continuously.

The prognosis should be reserved, because death may follow from general infection or as a result of the animal continuously lying down, or, in the event of its standing, severe laminitis may develop in

the opposite foot. When either tendon is injured the prognosis is always unfavourable, as necrosis almost always follows. Necrosis, however, not infrequently occurs even without the tendon being wounded. Treatment may succeed if commenced early, and consists in the most careful disinfection of the parts; in some cases it is advisable to operate and open the affected sheath.

Diagnosis is sometimes difficult because of the swelling which always exists around the wound. One symptom which always

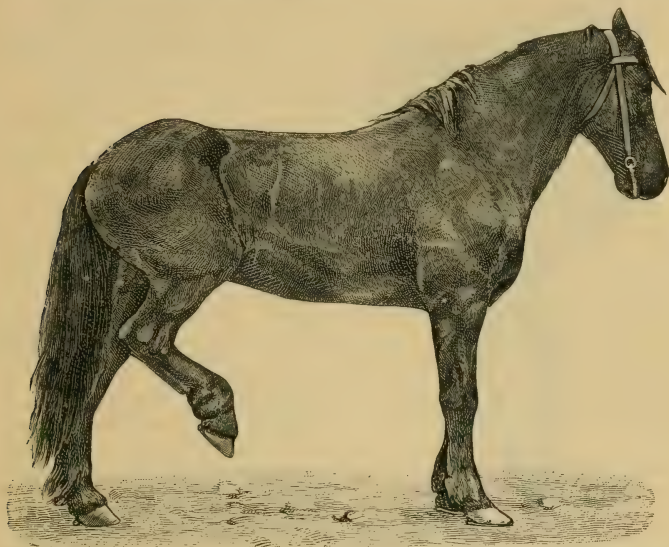


FIG. 555.—Position of the limb, in suppurative inflammation of the sesamoid sheath in the pastern (from a photograph).

accompanies inflammation of the tendon sheath should, therefore, be particularly remembered, viz., lifting of the limb, as in gonitis; in this case, however, the foot is carried further forwards (Fig. 555). This peculiar position is common, and seems absolutely pathognomonic. Accurate diagnosis is very important, because treatment is scarcely advisable, except in valuable horses. The **treatment**, which consists in daily cleansing of the parts, washing out with disinfectants, and bandaging, is not often successful. Continuous irrigation is seldom more beneficial. In a few instances, however, recovery occurs, though the fetlock usually remains somewhat knuckled; two cases

recorded show that perfect recovery is possible, even after acute suppurative inflammation of this sheath.

Chronic inflammation of this sheath is also seen in the horse. The clinical symptoms are not well marked; swelling is moderate, because the connective tissue surrounding the sheath is not much affected. At first, pain is not so great as in the acute disease, but after a time the swelling breaks at some point and a turbid synovia, which may be mixed with pus, is continually discharged. Much

difficulty is found in closing the wound in the sheath and in preventing further infection. Healing is almost always prolonged, and often owing to necrosis one of the tendons gives way. The condition is then incurable, and slaughter is advisable.



FIG. 556.—Rupture of the flexor pedis perforans tendon (from a photograph).

A horse was stabbed in the heel of the right hind foot with a manure-fork, and severe lameness at once set in. Being called the same day, Möller, thoroughly cleansed the wound, bathed the foot in creolin solution, and in the evening applied a large antiseptic dressing. The skin wound healed by primary intention, and pain diminished, though lameness continued. Möller therefore employed for the next few days moist warm applications, but the case did not improve. The animal was then regularly exercised, which greatly diminished the lameness, until one day pain returned in an unusually severe form, and the sheath of the flexor tendon was found to be greatly distended just above the fetlock-joint, and very painful on pressure. The parts were again bathed, and hot poultices applied, but, as they gave no relief, blistering was resorted to. There was, however, little improvement, the swelling persisting. The sheath of the tendon was then opened under antiseptic precautions, allowing the escape of a turbid fluid, which could only be distinguished from pus microscopically, but which was then found to contain no micro-organisms. The examination was made by various persons, and every precaution was taken to avoid error. One peculiarity of this case is very remarkable, viz., that in spite of the great distension of the tendon sheath the connective tissue around it never became the seat of cellulitis. In purulent tendovaginitis the tissues round the tendon sheath are almost always attacked with active cellulitis, and in consequence are more or less markedly swollen.

Dollar, called in consultation, saw a similar case in an aged grey hunter. The horse had been stabbed in the heel with a stable-fork; the wound closed, but lameness persisted. About the fourth day, swelling of the tendon sheath set in, lameness became acute, and a little offensive blood-stained pus escaped from the wound. The animal could not stand on the limb, and showed frequent lancinating pain. Dollar opened the sheath for a distance of about one inch, and prescribed continued hot antiseptic baths. The limb was immersed in a long rubber bath extending from the foot to the middle of the cannon bone, and the fluid was changed every two hours. Relief was prompt. In four days the baths were discontinued, as the skin was becoming macerated. A week later the wound had closed. Lameness gradually decreased; after blistering and three months' rest, the animal again carried his owner for an entire hunting season.

III.—INJURIES PRODUCED BY STRIKING (INTERFERING) AND THEIR COMPLICATIONS.

STRIKING or interfering is the term used to describe the injury inflicted by the horse's foot on the opposite leg during work. It occurs oftenest in the hind limbs, especially when the animal is trotted—the inner surface of the fetlock-joint is usually struck by the hoof of the opposite side; less frequently the coronet is the seat of injury. In the fore limbs, striking sometimes affects the carpus in horses with high action, and the metacarpus in those of defective conformation.

The nature of the injury produced depends partly on the tissues affected, partly on the time during which the effects continue. Thus in some cases the skin is simply bruised, in others the plantar nerves are involved; extravasation of blood or an abscess may occur on the inner surface of the fetlock-joint, or periostitis of the cannon bone may be produced. Violent and repeated injuries cause abrasion and necrosis of the skin or chronic bony enlargements on the inner surface of the fetlock-joint. Occasionally, fibrous enlargements, due to chronic striking, and showing marks of injury at their most prominent point, form on the inner surface of the coronet or pastern.

Interfering is serious, because the horse can never be depended on; riding-horses may stumble in consequence of bruising the inner plantar nerve, which lies on the fetlock-joint and is easily injured. But such injuries are also interesting to the surgeon, because they sometimes form the origin of disease processes of a grave character. The most frequent of these is septic cellulitis, which either extends in the subcutis, or to the aponeurosis and, taking a chronic course, continually suppurates. In other cases infection may invade the tendon sheath or the fetlock-joint, and produce incurable complications. Sometimes necrosis and chronic inflammation of the skin

result. Wilhelm describes a case in which striking was followed by severe cellulitis, necrosis of the skin, and, in consequence of metastasis, by pneumonia, inflammation of the shoulder-joint and subacute meningitis. The animal recovered, but very slowly.

Causes. Want of "condition," faulty conformation, and large size and flatness of the hoofs are the principal causes of striking. The animal may stand with the limbs too close together, or may turn the toes outwards. Both these peculiarities are accompanied by faulty action, which predisposes to the injury mentioned. Striking is also favoured by travelling on rough ground, and by debility, fatigue and exhaustion. Young horses often brush or strike while being broken in, or if, when driven, they are reined-up too short, especially before they become accustomed to work on paved streets. A very frequent cause of striking is, however, the mode of shoeing, the principal fault consisting in irregular paring of the hoof. If the inner wall be lowered and the outer left too deep, the fetlock-joint is thrust towards the middle line of the body when weight is thrown on the limb, and may be injured by the opposite foot. Many farriers still favour the idea that striking is prevented by lowering the inner wall, and thus perpetuate one of the most frequent causes of striking. Bad fitting, allowing the inner edge of the shoe to project beyond the wall of the foot, or leaving the clenches too long, may also produce the same result; but, in comparison with unskilful paring of the hoof, these only play a subordinate part.

Symptoms. The cause of these injuries is indicated by their position on the fetlock-joint, coronet, metacarpus, or knee. Sometimes the hair is only roughened or rubbed off, sometimes the skin is abraded, its surface being covered with blood or discharge, but more often there is a wound penetrating the cutis. Provided injury be confined to the surface of the skin, there is little or no pain, swelling, or lameness, and animals continue at work. Wounds due to brushing, when not infected, generally heal rapidly, unless the injury is repeated.

But immediately infection extends to the subcutis, a circumscribed swelling develops, which is followed by suppuration. The pain becomes severe, the animal goes very lame, and sometimes it is unable to bear weight on the limb. In extreme cases the animal sweats and is fevered. In such cases the plantar nerve may be inflamed, though more frequently the symptoms are due to cellulitis and abscess formation. The condition then becomes grave, because of the possibility of the fetlock-joint or tendon sheath becoming involved.

The injury may be followed by diffuse subcutaneous cellulitis, in

which case the swelling extends to the hock, or to the knee, invading more particularly the inner surface of the limb. The lymph vessels are generally swollen, the lymph glands enlarged, and fever is present. The superficial veins may be involved, and thrombosis result, but this complication is not so frequent as was formerly supposed.

The course taken by injuries due to striking varies very greatly. Provided the inflammatory process remains aseptic, and the injury be not repeated, it is of little moment, and recovery rapidly follows. Diffuse inflammation of the subcutis in horses is also usually mild. The swelling appears suddenly, and increases for two to three days, during which pain is marked, and some fever exists; the swelling, pain, and fever then begin to diminish, and in eight to ten days the animal is convalescent. Permanent blemishes are rare, but under some circumstances, especially if the cellulitis has been accompanied by pyogenic infection, abscesses form in the upper parts of the limb, high fever sets in, septicæmia develops, and soon leads to death. Such complications, however, are rare.

Subaponeurotic cellulitis is graver, either when confined to the fetlock or coronet, or when appearing in a diffuse form. In the first case a circumscribed, very painful swelling develops around the fetlock-joint, and after eight to fourteen days, or later, breaks and discharges a very offensive pus, mixed with fragments of necrotic tissue; the pain then diminishes, and recovery follows. Sometimes the abscess re-forms, and the disease may then last for a longer time.

When purulent inflammation of the fetlock-joint occurs, the pain and fever increase, no weight can be borne on the limb, and even slight movements of the foot aggravate suffering. The condition is then incurable. Injuries to the coronet may in a similar way be followed by purulent inflammation of the pedal or coronet joints, and cellulitis extend to the sheaths of the flexor tendons, with equally fatal results.

Treatment. Among the most important preventive measures is attention to the horse's general condition and to feeding. Young horses should be gradually brought into work, and not be called on for great or continued exertion until their muscular system is properly developed. To prevent striking, special attention should be paid to the shoeing, and the application of a so-called "anti-cutting-shoe" will be found very useful, especially on hind feet. Shoes for "cutting" and "brushing" are fully described in Dollar and Wheatley's "Horse-shoeing and the Horse's Foot." After lowering the outer wall sufficiently to, at least, prevent it meeting the ground sooner than the inner, the edge of the latter is somewhat rounded off, and a close-

fitting anti-cutting shoe applied. Should the inner wall be too low, it must be raised by placing leather, &c., under the shoe.

Rings and boots, often recommended against striking, are seldom of much value. Some horses are so apt to strike, that not even the most careful shoeing is sufficient to prevent them injuring themselves, and in such cases boots may be tried. They require, however, to be so fashioned as not to be displaced if struck, nor cause injuries if tightly buckled. The best form of boot contains a zinc plate exactly responding to the oval form of the fetlock.

The straw and indiarubber rings often used in draught-horses force the animal to move with the feet further apart, but have no permanent effect on the action, and as soon as they are removed the animal strikes as before. A "Yorkshire boot" is useful in dry weather, and can be made more effectual if before folding down the upper part a thin straw plait be wound regularly round the point struck. When the upper portion of cloth is folded down it secures the plait in position.

Injuries produced by striking must be treated according to their character. Complications are best prevented by carefully cleansing the wound, and dressing it with iodine or other antiseptic. Such precautions are particularly necessary in winter, and when the roads are dirty. Especial care is required if the skin be perforated, as the entrance of infective material into the subcutis then is greatly favoured.

When suppuration is already established, the first precaution must be thoroughly to cleanse and disinfect the wound, so as to prevent further extension. After-treatment is based on general principles. Cold applications are contra-indicated; more useful is moist heat in the form of warm baths containing a disinfectant. Immediately pain diminishes and swelling commences to recede, slow exercise should be given to hasten resorption.

Double precautions are required in subaponeurotic inflammation. When located in the fetlock or near the tendon, lukewarm baths, containing antiseptics such as Cofectant, carbolic, &c., are indicated, and immediately fluctuation can be detected the swelling should be opened, though due care must be exercised to avoid injuring blood-vessels and nerves, or opening the joint or tendon sheath. When the joint or the tendon sheath is plainly implicated operation is better avoided, because in such cases no good can result, and the owner is apt to conclude that the use of the knife was responsible for the fatal result.

F. DISEASES OF THE FOOT.

As diseases of the feet are fully dealt with in Dollar and Wheatley's "Horse-shoeing and the Horse's Foot," it is here only necessary shortly to consider such of the inflammatory processes within the foot as have a direct bearing on veterinary practice.

(A) ACUTE INFLAMMATION OF THE KERATOGENOUS MEMBRANE.
 PODODERMATITIS ACUTA.

Acute inflammation of the keratogenous membrane is, with few exceptions, produced by infection with micro-organisms, and in most cases is preceded by mechanical injuries. On account of the sensitive laminae and sole being bounded on one side by the unyielding horny box, and on the other by the os pedis, inflammatory swelling, especially when of a septic nature, must be painful, and tend to necrosis. The latter, though to some extent antagonised by the great vascularity of the parts, is nevertheless not infrequent.

The surface of the sensitive membrane possesses a well-developed stratum mucosum, formed of numerous layers of epithelium, which, however, show no horny character. Not infrequently inflammation is entirely confined to this without extending to the corium, a condition termed superficial pododermatitis, in contra-distinction to inflammation of the deeper-lying structures corresponding to the corium and subcutaneous connective tissue, which is termed parenchymatous pododermatitis.

(1) Pododermatitis superficialis generally follows exposure of the tissue of the rete mucosum and entrance of infective material, as in nail puncture. Septic products, &c., penetrate by the nail tract as far as the rete mucosum, and may give rise to extended inflammation. In such cases we speak of a prick or stab. If, on the other hand, the point of entrance was an opening between the wall and sole, the condition is termed separation; while if it occur in the angle between the bar and wall, it is called suppurating corn.

Aseptic inflammation of this tissue, though rare, is seen during laminitis and formation of horn tumours, &c. In these cases the rete mucosum is sometimes thickened, as shown in laminitis, by increase in width of the white line. The horn produced during inflammation is sometimes changed in character, stained yellow, or infiltrated with blood (simple corn). Infective pododermatitis superficialis, on the other hand, is always accompanied by suppuration; the thick layers of rete break down under the action of the infective material, though exudation certainly occurs in the neighbouring portions of the corium.

This explains the tendency of the process to remain confined to the surface, and to extend along it towards the coronet, or, when the white line is the seat of attack, to extend along the thick layers of non-horny rete cells of which it consists.

Though aseptic pododermatitis superficialis ends in resolution or chronic thickening, the infective form is seldom followed by resolution, but the pus escapes outwardly, or into the cutis or subcutis, in which it produces inflammation. That the broken-down masses of rete do at times become absorbed is shown by the spaces occasionally found in the horn when cutting out a hoof. The same condition is often seen in the claws of herbivora. Sometimes several spaces are discovered one above the other, showing that the process has occurred repeatedly, and been interrupted by periods of normal horn formation.

As a rule, septic pododermatitis superficialis ends in perforation outwardly, though it often requires surgical assistance. The condition having been diagnosed and the horn cut away, a greasy, blackish fluid, termed horn pus, escapes, and the animal soon recovers if the parts be properly dressed and protected against fresh injury or infection. When, however, an artificial opening is not made the infecting process extends, and the pus, accumulating between the laminae and horny wall, reaches the coronet, where it forms an abscess "between hair and hoof." Inflammation of the lower border of the laminae, or periphery of the sensitive sole, generally extends in the direction of the white line, and the pus, therefore, tends to escape at the heel. **The discharge of fluid, grey or blackish material, termed "horn pus," at the coronet or heels, and the absence of marked swelling, point to the superficial nature of the attack.**

(2) Pododermatitis parenchymatosa affects the corium or subcutis, and is generally associated with disease of the surface, from which it may originate, though it also results from deeper injuries, like pricks, &c. The podophyllous membrane, or its subcutis, forms the seat of acute inflammation, accompanied by exudation; suppuration almost always occurs, the pus being precisely similar in character to that formed in other portions of the skin, and appearing thick, yellow, and creamy, while, if its formation is accompanied by necrosis, it may be offensive. The character of the discharge, in fact, is a very valuable indication for diagnostic purposes. When white, yellowish or creamy, the keratogenous membrane is evidently suppurating; if reddish, or of the colour of wine lees, and stinking, it indicates diffuse necrosis of the membrane, which, again, is often accompanied by necrosis of the os pedis; when yellowish, viscous, "curdled," or containing fibrinous flocculi, and especially if escaping

by a sinuous opening in the coronet, or the hollow of the pastern, it points to synovitis of the lower sesamoid sheath, or to arthritis of the pedal-joint. The significance of these peculiar characters in the pus is again controlled by the degree of pain and general disturbance.

The attack may terminate either in **resolution**, **abscess formation**, or **necrosis**. The first rarely happens. Much more frequently an abscess forms, similar to those in other positions, and leads to either—necrosis of the sensitive membrane, purulent cellulitis, or systemic infection.

Necrosis usually depends on infection with particularly virulent bacteria, or the necrosis bacillus, though it is favoured by the position of the sensitive laminae and sole between the unyielding horn on the one side and the os pedis on the other, which causes any considerable swelling to be followed by severe compression and interference with circulation. If the first point involved is one where the sensitive structure lies closely in contact with the bone (as is the case over the greater part of the sole and wall), necrosis frequently attacks the os pedis. Purulent cellulitis can, of course, only occur in structures possessing a subcutis, like the frog and coronary band and the posterior sections of the keratogenous membrane of the wall and sole.

Inflammation attacks the connective tissue lying below the coronary band, producing a subcoronary inflammation, which usually involves one-half of the hoof, occasionally the whole, and is recognised by the severe swelling and intense pain around the coronet. As infection may extend into the pedal joint, the condition is grave. When occurring towards the back of the coronet, this form of inflammation generally leads to sinuses or quitters, which, however, are still more often the result of suppuration in the posterior sections of the sensitive sole or wall, where the subcutis is in contact with the lateral cartilages.

Parenchymatous pododermatitis in the sensitive frog often causes purulent cellulitis of the plantar cushion, and is particularly dangerous, on account of so often extending to the flexor pedis perforans tendon and producing necrosis. Purulent cellulitis of the cushion is distinguished by the violent pain shown, especially on dorsal flexion of the phalanges. When weight is placed on the affected limb the parts are kept in a condition of excessive volar flexion; weight can only be borne for a moment, and the animal puts down the foot with the front of the wall quite upright, or directed downwards and backwards. Swelling appears in the hollow of the heel; after some time abscesses

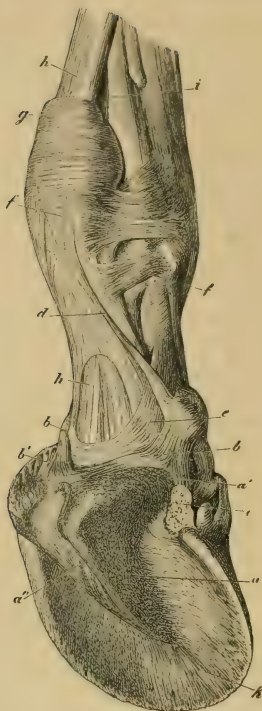


FIG. 557.—To illustrate the superficial structures involved in surgical injuries of the foot. The outer lateral cartilage and the tissues covering the lower surface of the pedal bone (sensitive frog and sensitive sole) have been removed. *a*, Plantar cushion; *a'*, bulbar portion of plantar cushion; *a''*, cleft of the frog in which rests the "frog stay"; *b*, origin of the so-called "suspensory ligament of the bulbs"; *b'*, small elastic band passing towards the lateral cartilage; *c*, elastic band arising from lateral cartilage and becoming inserted into pastern bone—it unites with *b*; *d*, small tendon which arises from the skin and becomes attached, in common with *b* and *c*, to the pastern bone; *e*, fibro-elastic supporting sheath of flexor pedis perforatus; *f*, fibro-elastic supporting sheath of flexor pedis perforatus; *g*, flexor pedis perforatus tendon; *h*, flexor pedis perforatus tendon; *i*, suspensory ligament; *k*, lower surface of pedal bone, to which the flexor pedis perforatus tendon is attached.

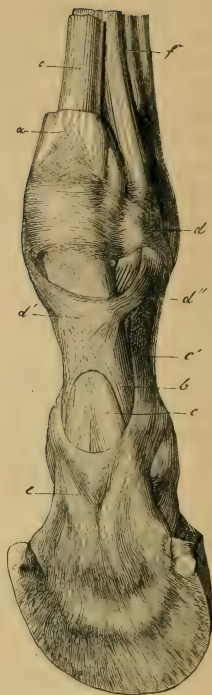


FIG. 558.—To illustrate the deeper-seated structures involved in surgical injuries of the foot. Right fore foot seen from behind and slightly from one side. *a*, Flexor pedis perforatus tendon; *b*, two limbs formed by its bifurcation; *c*, flexor pedis perforans tendon; *d*, fibrous reinforcing band of great sesamoid sheath; *d'*, fibrous supporting sheath inserted into sufraginis bone by four heads; *d''*, upper insertions (the lower not visible in figure); *e*, fibro-elastic plate covering the lower surface of flexor pedis perforans and inserted into sufraginis bone at *e'*; *f*, suspensory ligament.

form and break, and not infrequently the plantar aponeurosis becomes inflamed and, later, ruptured.

(3) Septicæmia or general infection sometimes results from necrosis of the sensitive laminae or sole, especially when the disease attacks the os pedis. The pedal veins offer little resistance to infective material penetrating their walls, and reaching the general circulation. Spinola drew attention to the frequent connection between necrosis of the pedal bone and attacks of septicæmia. The constant and severe pain also causes the patients to lie continually, and, further, predisposes to blood-poisoning.

Causes. With the exception of laminitis, which will later receive attention, acute inflammation of the sensitive structures of the foot is due to external injurious influences. Mechanical injuries, like bruises, wounds by driven or picked-up nails, or separations of the wall allow of irritants reaching the sensitive parts directly; in other cases the injury is thermal, but as the horny box forms an excellent protection against ordinary changes in temperature, and as burns from hot-fitting of shoes are nowadays rare, such cases are much less frequent. Pricks in shoeing

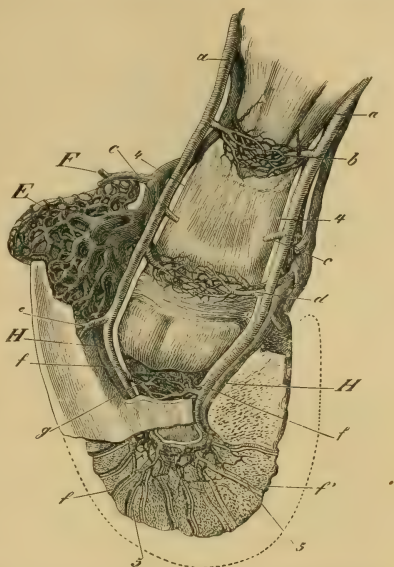


FIG. 559.—To illustrate the joints and deep-seated arteries, veins and nerves involved in surgical injuries of the foot. Right fore foot, seen from below, behind, and somewhat from one side. The outer lateral cartilage is removed, together with sufficient of the pedal bone to render visible the vessels, &c., in its interior. The nerves accompanying arteries *f'*, are shown too thick; they should be less than half as broad as figured. *a*, Digital artery; *b*, posterior suffraginal artery; *c*, artery of plantar cushion (cut through); *d*, posterior artery of coronary circle; *f*, plantar artery, which anastomoses with its fellow within the pedal bone, and gives off twigs *f'*, which pass to the anterior surface of the pedal bone, just above its lower edge; *g*, twigs of plantar artery supplying coffin joint; *E*, deep lateral layer of coronary plexus, clothing inner surface of lateral cartilage; *F*, divided ends of superficial part of coronary plexus. From these arise the digital vein (not shown) *H*, plantar vein; *4*, posterior branch of digital nerve accompanying vessels into pedal bone; *5*, twigs of posterior branch passing towards sensitive laminae.

or excessive paring of corns may be followed by irritation, especially if the roads are very dirty. Frostbite of the heels has been seen. Chemical substances, like acids, employed by farriers in treating

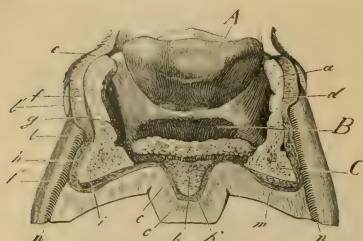


FIG. 560.—Vertical cross section of a foot seen from behind. To illustrate the structures involved in surgical injuries of the foot. *A*, Coronet bone; *B*, navicular bone; *C*, pedal bone; *a*, lateral cartilage; *b*, anterior portion of plantar cushion; *c*, divided part of flexor pedis perforans tendon; *d*, postero-lateral ligaments of navicular bone; *l*, horn wall; *m*, horn sole; *n*, white line; *o*, horn frog.

substances. The course and consequences of the inflammation depend chiefly on the virulence of these organisms.

Diagnosis. The presence of acute inflammation of the sensitive wall or sole may often be detected by the peculiar action of the lame leg. As pressure within the hoof is increased when weight is thrown on the limb, lameness is most marked during movement, especially over stones, though in the stall the foot is often rested and sometimes elevated.

The foot must be carefully examined to detect deformities or fissures in the horn. (The manner of conducting this examination is fully described in Dollar and Wheatley's "Horse-shoeing and the Horse's Foot.") Palpation will

disease of the feet, sometimes cause inflammation. But by far the most frequent and important cause of acute inflammation is infection with pus cocci and other micro-parasites. Normally, the soft parts are protected by the horny wall, but as soon as a fissure exists, in consequence either of pricks in shoeing, picked-up nails, the formation of sand-cracks, or separation of the wall, a way is opened for infection, which is especially liable to occur, as the hoof is continually covered with dirt containing infective

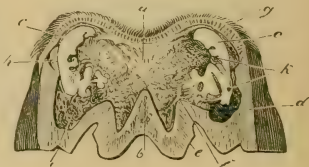


FIG. 561.—Vertical cross section of foot seen from behind (this section has been made nearer the heels than Fig. 560). To illustrate the structures involved in surgical injuries of the foot. *a*, Posterior part of plantar cushion; *b*, median ridge of frog; *c*, lateral cartilage; *d*, horn wall; *e*, lateral face of frog; *f*, point of union between the bars and frog.

detect increased warmth and pain.

Prognosis. The degree of danger depends chiefly on the position and character of the inflammation. Whilst pododermatitis super-

ficialis only proves dangerous in the region of the bars, whence it may extend to the plantar cushion, and in general yields readily to treatment, parenchymatous inflammation often leads to severe complications. Any disease affecting the posterior portions of the foot is apt to prove serious, because of the readiness with which diffuse cellulitis occurs in this region, and of the frequency with which it is succeeded by quittor formation, disease of the plantar cushion, navicular sheath, or flexor pedis perforans tendon. Other things being equal, injuries to the hind are more serious than those to the front feet, because the hind limbs sustain more weight and can less easily be rested, and also because they perform a more important function than do the front—*i.e.*, they not only support, but also propel the body. Injuries of the feet are also less important in heavy than in light horses, because the former can often be made serviceable at a walking pace, though unable to trot sound.

As in many instances it is impossible to discover the extent or character of the process, the prognosis must be based on indirect indications. The principal of these are the degree and duration of the pain. As a rule, the more stubborn and severe the lameness the graver the prognosis, especially when no direct cause is apparent, as, for example, when there is no protrusion of soft tissues. Necrosis and purulent cellulitis of the plantar cushion, or subcoronary connective tissue are exceedingly dangerous. The condition is also very grave when laminitis results from continuous standing on the opposite foot. Increase in pain, especially when of a lancinating character, inability to stand on the affected foot, and a rising temperature indicate grave complications, like suppuration, and necrosis.

Treatment. Although treatment follows general principles, yet in acute inflammation of the sensitive structures of the foot, certain special precautions must be borne in mind. The advice to as far as possible remove the cause is eminently applicable here. Aseptic pododermatitis seldom calls for more than rest and cold applications in the form of poultices or continued irrigation. These soften the horn and permit it to yield under the pressure of the soft structures, while they directly diminish congestion. As a precaution, however, after applying moisture for long periods, the hoof should be greased, to prevent it completely drying again. When lameness disappears, special attention must be given to shoeing.

Superficial inflammation, accompanied by suppuration, is best treated by thinning the horn, and allowing the pus to find early exit. An opening of a quarter to half an inch in circumference is

sufficient to allow of the thin fluid pus escaping, after which the cavity is washed out and injected with a disinfectant. Foot-baths are sometimes useful, but only clean water containing a disinfectant should be used. The opening should be covered, first, with a mass of cotton-wool saturated in a disinfecting solution, and then with a proper cotton-wool dressing to exclude dirt, and plenty of clean, dry straw given as bedding. The dressing must be renewed several times a day. As a rule, with these precautions, recovery occurs in five to eight days. As already remarked, particular care is required when inflammation affects the bars.

The treatment of parenchymatous pododermatitis, accompanied by suppuration, requires greater care. To prevent the occurrence of purulent cellulitis, pus must be allowed free exit. The diseased area should, therefore, be exposed as far as possible, and neighbouring parts thinned, though without removing more horn than is absolutely necessary. Thinning the horn relieves inflammatory swelling around the suppurating centre. The next precaution is to remove all putrefying material from the inflamed cavity. For this purpose the parts are carefully washed with sublimate solution, or, if necessary, immersed in a disinfectant foot-bath. They are next rinsed with sublimate or carbolic solution, a tampon saturated with the same material applied to the exposed soft tissues, and a pressure dressing fastened over all. It is often necessary to inject the parts with 10 per cent. chloride of zinc solution, or hydrogen peroxide.

A pressure dressing answers the double purpose of protecting the inflamed spot from dirt and the entrance of fresh infective material, and of preventing protrusion of granulations. To remedy this, nothing succeeds better than steady pressure, assisted, if necessary, by astringents like alum and tannin, or even by nitrate of silver. Dusting the granulations with iodoform or other disinfectant powder also helps to combat the inflammation. Very special care is called for when the pus is offensive. Foot baths are useful on account of their cleansing the point attacked, but as they favour prolapse of soft tissues, a pressure dressing should be applied. As soon as suppuration stops, the soft parts must be protected by means of a dressing of tar and tow, until they again become covered with horn. This dressing should not be removed until the wound has thoroughly cicatrised, when a well-fitting shoe, protecting the diseased point until the new horn becomes sufficiently strong, is applied.

In necrosis of the sensitive sole the affected point must be completely exposed, the dead tissue removed, and the freest possible exit given to discharge. Necrotic portions of tissue are grasped

with dressing-forceps or removed with the curette, after which the parts are treated as described.

I.—PRICKS OR STABS IN SHOEING.

THE sensitive portions of the foot are sometimes injured during shoeing by misdirected nails, with consequences of a very varying character. The chief factor appears to be infection, though the degree of injury plays no inconsiderable rôle in determining the result. When the nail only penetrates the neighbourhood of the rete mucosum, or injures this alone, a superficial inflammation results, with the above-described consequences. But if, instead, portions of the cuticular structures containing connective tissue are affected, the usual, though not invariable, result is an attack of parenchymatous inflammation. The attack may often be avoided by immediately withdrawing the nail and closing its track by tar, wax, or by burning the horn, thus preventing infection of the wound; a proof that it is not the injury, but the infection it facilitates, which causes inflammation. A second nail should not be driven at the same spot, as it would again open the path for infection.

The *os pedis* is occasionally injured by driven nails, though necrosis resulting from inflammation should not be mistaken for fracture produced by a nail.

The course of these injuries varies greatly. Superficial injuries sometimes heal, without proceeding to suppuration, in six to eight days under local treatment and rest. Pododermatitis superficialis produced by pricks is generally followed by suppuration; infection extends, and the pus, if not furnished with an outlet, breaks through at the coronet at a point corresponding in position with the misdirected nail. Although in such cases spontaneous recovery is usual, it saves time, and the possibility of complications, if an exit for pus be provided at some point in the white line.

As pricks and stabs only occur in those portions of the sensitive structures which lie immediately in contact with the *os pedis*, and are unprovided with subcutis, purulent cellulitis is a comparatively rare

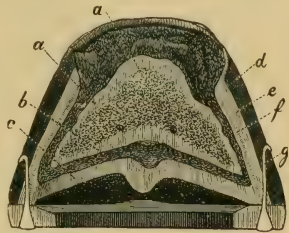


FIG. 562.—Cross section of a sound and well-shod hoof, showing the proper position of the nails. *a*, Pedal bone; *b*, sensitive sole; *c*, horny sole; *d*, horn wall; *e*, dark-coloured outer layer of do.; *f*, laminal sheath; *g*, nails.

complication, necrosis of the laminae, and even of the os pedis, being more frequently seen. As already remarked, the result depends more on the kind and degree of infection than on the extent of injury. Direct injuries of the bone lead, as a rule, to necrosis, which is apt to invade the neighbouring sensitive structures.

The diagnosis is based partly on the fact that the horse goes lame soon after shoeing and partly on examination of the hoof. For this purpose the shoe is removed, and the ground surface of the hoof, and especially of the white line, well cut out, so that the position of each nail-hole can easily be detected. If it is necessary to expose a nail tract, it should first be followed through the horn of the sole and white line, the wall being spared, so as to preserve a sufficient bearing surface for the next shoeing.

Causes. Want of care and skill on the part of the farrier is the usual cause of stabs or pricks, though they may be due to bad feet and to the animal's restlessness, without any fault on the part of the farrier. Carelessness in shoeing is shown by the nail holes being misdirected, and by their occurring at points where there was not sufficient horn to warrant the driving of a nail. The usual causes of stabbing are coarsely-punched nail holes and insufficient horn; stubs left in the feet rarely occasion pricks by causing the nail to deviate from its normal direction.

The first step in **treatment** is to remove the nail and shoe. Provided suppuration has not set in, cold applications, in the form of antiseptic foot-baths or poultices, may be tried. The part must be cleansed, and infection prevented by applying a suitable dressing. Once suppuration occurs, treatment follows the above-described principles.

II.—PICKED-UP NAILS. PURULENT CELLULITIS OF THE PLANTAR CUSHION. RESECTION OF THE FLEXOR PEDIS PERFORANS.

THE above title will, for convenience, be regarded as including all injuries caused by the animal treading on foreign bodies which thus penetrate the soft structures of the foot. Such bodies include nails and wire, as well as pieces of iron or glass. As the horny sole usually offers sufficient protection, such foreign bodies almost invariably enter through the frog, and may injure the plantar cushion, or perforans tendon, navicular sheath, os pedis, os naviculare, or pedal joint. On account of their different behaviour when injured, we distinguish—(1) a horny frog, (2) a sensitive layer, and (3) a fibro-fatty frog. The two latter are usually included under the term “plantar cushion.”

The foreign body usually glides off the bars and penetrates the side or furrow of the frog.

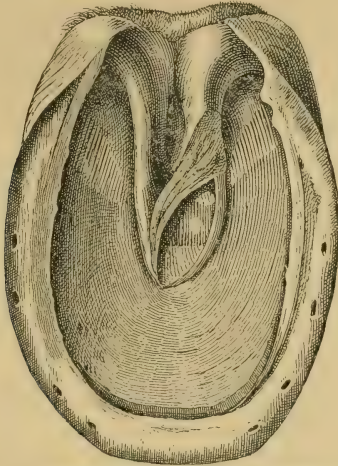


FIG. 563.—Operation for partial resection of the aponeurosis of the flexor pedis perforans tendon.

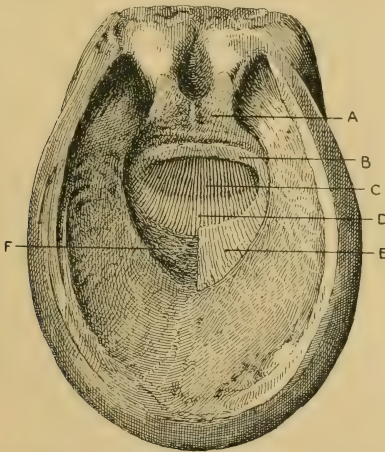


FIG. 564.—Operation for complete resection of the aponeurosis of the flexor pedis perforans tendon. A, Cut surface of frog and plantar cushion ; B, section of the aponeurosis of the flexor tendon ; C, postero-inferior surface of the navicular bone ; D, interosseous ligament ; E, oblique section of the aponeurosis of the flexor tendon ; F, tendinous surface of navicular bone cleaned by curetting.

Provided injury is confined to the surface of the sensitive frog, no bad results usually follow ; but should the plantar cushion be involved, diffuse purulent cellulitis may set in, suppuration may extend to the perforans tendon, and be followed by necrosis of the latter and by suppuration in the navicular bursa. The condition is then excessively dangerous, and animals may succumb if treatment be delayed. The rapidity of the process is largely determined by the virulence of the infective material.

Prognosis depends, therefore, firstly on the position of the injury, and afterwards on its extent and the character of the infection. The depth of the wound may be determined by the length of the foreign body removed, and sometimes by probing ; but as the probe may easily become the vehicle for introducing infective material into the depths of the wound, it should be used with considerable care.

The position of the injury is important, the most dangerous spot being the centre of the frog, immediately above which lies the navicular bone covered by the flexor pedis perforans tendon. Injuries at the point of the frog may extend to the lower surface of the os pedis, causing necrosis, which, however, is seldom so dangerous as disease of the tendon or bursa, because necrosis usually remains confined to one spot, and healing occurs after exfoliation, even though the latter occupy a considerable time (three to four weeks). Severe lameness, and symptoms of diffuse purulent inflammation of the plantar cushion, are always grave. On attempting to bear weight on the foot, the latter shows excessive volar flexion, swelling appears in the heel, and pain is exhibited on forcibly flexing the toe.

Treatment. The chief indications are to prevent infection, to disinfect the wound, and to limit inflammation. After carefully removing the foreign body and taking precautions against any particles being left behind, the entire hoof must be pared as for shoeing, and any loose fragments of horn removed from the sole or frog. The track of the nail should then be cut out until the injured tissues are exposed. The funnel-shaped opening, and, if possible, the wound of the tissues, are then washed out with a disinfectant (a syringe is useful) ; or the parts can be swabbed with a tampon saturated with 10 per cent. chloride of zinc solution or hydrogen peroxide. As the chief object is to keep the wound disinfected, a dressing moistened with some disinfecting fluid is applied over all.

Should pain increase during the next few days, the wound should be cautiously opened up, and imprisoned discharge allowed to escape, after which the foot is immersed twice a day, for one to two hours at a time, in a bath containing some disinfectant. Plenty of clean

straw bedding must be given, and the dressing moistened five or six times a day.

To sum up, the object of treatment is, to confine the inflammation to the point of injury, for which purpose it is necessary to keep the parts thoroughly clean, to avoid retention of pus or wound discharge and prevent extension of infection.

When pain decreases, a dry dressing is sufficient ; and as soon as inflammation or suppuration stops, a splint dressing can be applied to protect the soft parts, which are only covered with a very thin layer of horn. The sole is smeared with tar and covered with tow, which is retained by means of two hoop-iron splints placed one over the other in the form of a cross, with their ends thrust under the shoe. Provided the roads are dry, the horse can work with this protection, but in wet weather it is better to give a few days' further rest in the stable.

When suppuration is confined to a portion of the fibro-fatty frog, precautions should be taken against further infection and retention of pus, which would lead to diffuse cellulitis of the whole structure.

In cases where the perforans tendon and its bursa are still intact, it is sometimes useful to scrape out the wound with a curette. This removes the infected granulation tissue which forms rapidly and constitutes an obstacle to the escape of wound discharge. After sponging out with chloride of zinc solution, a tampon, moistened with the same fluid, is thrust into the wound, and a dressing applied.

Disease of the perforans tendon can in general only be cured by resection. The procedure is as follows:—On the day preceding operation, the sole, frog, and especially the bars, are very thoroughly thinned, the foot is scraped, washed and cleansed, the hair clipped carefully away as high as the fetlock, and the limb immersed for an hour in a bucket of strong disinfecting solution. Whilst immersed it is subjected to a thorough scrubbing with a clean stiff brush. Immediately after removal the foot and hoof must be completely enveloped in clean cloths saturated with a disinfecting solution.

Next day the horse is cast. The affected foot is released, the sole, frog, and bars still further thinned, and the sensitive frog is exposed so as to allow any necrotic portions either of the frog or tendon to be removed. An Esmarch's bandage is then applied to the limb, commencing at the coronet and extending to above the knee, at which point a stout rubber cord under tension is passed several times round the limb and the ends tied together. This secures the operator against troublesome bleeding. The foot to be operated on may then

be fastened to the other limb of the same side by means of webbing. Meantime the horse is anæsthetised.

Two methods of procedure are at the operator's disposal, in the first of which only a portion of the point of the frog is removed, in the second the whole. The first method is often sufficient to disclose the diseased tissues, and it has the advantage of producing a much smaller, and therefore more rapidly-healing, wound than the second. The sole, frog, and bars having been pared until they yield everywhere to a slight pressure with the finger, a grooved director is passed into the sinus, which is freely laid open to its extremity. Using the curved knives shown in Fig. 569, the edges of the wound and the plantar cushion are then removed so as to produce an elliptical opening, at the base of which lies the perforans tendon. If the superficial fibres of the tendon are necrotic the operator may confine himself to removing such diseased tissue. But much more frequently he finds it necessary to remove the entire thickness of the tendon beneath the diseased spot and to extend his incision laterally so as to operate in sound tissue. The portion of the navicular so exposed may be curetted, if it show signs of disease. The wound is then washed out with a disinfectant, dusted freely with iodoform, and filled with masses of disinfected tow, or wood-wool.

When carefully performed this partial operation is sometimes rapidly successful, but on the whole it is apt to prove uncertain, and to be followed by troublesome complications. The tendon sheath becomes the seat of suppurating synovitis; the navicular bone shows superficial necrosis; abscesses break in the flexure of the pastern, and the remaining portion of the flexor tendon becomes necrotic. In really grave cases where operation of this nature is necessary it is usually best at once to perform the operation implicating both sides of the frog.

The preliminary precautions are as before mentioned. The foot should be extended by an assistant, and the plantar cushion divided transversely close to its base, with the double-edged curved knife already referred to. The section should be at an oblique angle with the general surface of the frog, and in such a direction that when prolonged inwards it will meet the posterior edge of the navicular bone. The half-detached fragment of the plantar cushion is then grasped with forceps and freed from its lateral adhesions by two cuts along the lateral lacunæ of the frog. The deep face of the plantar cushion is in contact with the flexor aponeurosis.

Using both hands to steady the knife, the operator now divides the aponeurotic portion of the tendon transversely close to the posterior

border of the navicular bone with one steady cut. The portion of the aponeurosis thus freed is next divided along the middle line from before backwards as far as the upper margin of the navicular bone, the margins are reflected and each is carefully dissected free. Again grasping the knife with both hands, the operator makes a semi-circular sweeping cut along the edge of the semi-lunar crest, thus dividing the lower insertion of the aponeurosis into the os pedis. The pieces are then removed.

The fibro-cartilage covering the lower surface of the navicular bone is next removed by the vigorous use of the curette. If the primary injury extend to the point of insertion of the plantar aponeurosis the terminal fibres of the tendon must be carefully removed and the semi-lunar crest curetted, care being taken, however, not to open the joint between the navicular bone and the os pedis. If, however, the insertion of the aponeurosis is healthy the semi-lunar crest should not be touched; the fibrous layer which covers it soon becomes vascular, and granulates rapidly provided it be protected from infection. Wherever necrosis exists it is absolutely imperative to remove the whole of the diseased tissue, and, in fact, to encroach a little on the adjoining healthy parts. To overlook a fragment of diseased tissue is to risk the necessity for operating anew and under much more difficult conditions. The cavity is sponged with a 10 per cent. solution of chloride of zinc, rinsed with carbolic solution, powdered with iodoform, salol or calomel, firmly packed with masses of tow, moistened with carbolic or sublimate, and a moist dressing applied over all. French operators touch any point in the wound which may appear likely to undergo retrogressive changes with tincture of iodine. The space is filled with tow, partly to check the bleeding which follows removal of the tourniquet, partly to restore the fibro-fatty frog and its sensitive covering to their normal position. Next day the dressing is removed, the wound rinsed out with disinfectants, and the dressing renewed, but the cavity is only loosely filled with carbolic tow or jute. This second dressing remains in position eight to ten days, provided it is not wet through with discharge, and neither fever nor severe pain has set in. In the interval the walls of the space have everywhere become covered with granulations—in favourable cases without any trace of pus formation. The dressing is then renewed every four or five days; and as the cavity fills with granulations, less material is used. Finally, healing becomes complete; the frog may possibly appear rather shortened, but, as a rule, no other deformity remains. French and German operators often return horses to work in four to six weeks, but

it is best to keep a protective dressing splinted on the sole for some time.

A very convenient method of applying the above dressings is by means of a shoe fitted with a thin iron plate of sufficient size to fill up the entire space between the limbs of the shoe, to which it is fastened by screws. (See "Horse-shoeing and the Horse's Foot.")

The best results are seen in heavy draught-horses. In carriage and trotting horses slight lameness may persist for a considerable time, though it seldom proves permanent. (Full clinical details of several cases of resection of the flexor tendon are given in "Clinical Veterinary Medicine and Surgery.")

Partial resection of the flexor tendon is not to be recommended, because the navicular bursa is generally implicated, and therefore, after removal of the necrotic portion, purulent bursitis continues, and leads to fresh necrosis of the tendon. For this reason reports of success after partial resection of the perforans tendon are to be received with caution. The fact that recovery has been described as occurring in eight to fourteen days, or even earlier, shows that the cases were not cases of necrosis of the flexor tendon, but only of the fibro-fatty frog. In these it is often sufficient freely to scrape the parts with the curette.

III.—TREADS AND INJURIES TO THE CORONET. PURULENT INFLAMMATION OF THE SUBCORONARY CONNECTIVE TISSUE.

TREAD is usually a self-inflicted injury, and produced by the heel of one foot treading on the coronet of another; in pair horse work the bruise may be caused by the second horse. Contused wounds of the coronet caused by carriage or omnibus wheels at first present somewhat similar appearances, but affect to a greater degree the deep-seated tissues, produce at a later stage distortion of the hoof, and, worst of all, are apt to be followed by the formation of extensive exostoses and permanent lameness. Either the coronary band, the upper portion of the wall, or the skin is divided, and the injury often extends to subcutaneous structures, to the tendon of the extensor pedis, to the lateral cartilage, or to the os pedis, and may even open the pedal-joint. The danger is increased by the fact of the wound being bruised and infected from the beginning, for which reason treads seldom heal by primary intention, and generally show a tendency to necrosis. The structure and position of the injured part favour this; the tendon, the os pedis, and the lateral cartilage are readily attacked, whilst necrosis is favoured by the surroundings of the coronary band, in which acute inflammatory swellings greatly

interfere with nutrition, in consequence of the unyielding character of the horny wall. Finally, as treads most frequently occur during winter, the tissues are exposed to the action of cold and dirt, which are specially injurious. At this season of the year slight injuries to the coronet are readily followed by severe sloughing processes, which show a strong tendency to extend to the sensitive laminae. Again, infection of the loose connective tissue lying under the coronary band often leads to diffuse cellulitis, which may extend to the pedal-joint, and give rise to incurable purulent inflammation.

Destruction of a section of the coronary band is followed by cessation in the secretion of horn at that particular point. Acute inflammation of the band also interrupts the formation of horn, and produces a cavity in the horny wall, the width and length of which depend on the size of the region affected and on the time during which inflammation persists; the longer the time, the greater the perpendicular measurement of the cavity; the greater the extent of coronary band involved, the broader the resulting defect. When horn production is permanently checked, a depression forms in the wall, and gradually grows downwards until it extends from the coronet to the ground surface of the foot. To discover whether the horny wall will again recover its normal shape, the horn below the coronary band must be inspected.

A further obstacle to recovery consists in the papillae of the coronary band becoming thrust out of place, and not returning to their normal position. During acute inflammation the papillae of the coronary band are displaced relatively to one another, and must regain their former position before they can again produce a normal growth of horn. This is effected by the neighbouring papillae, which have not suffered displacement. As the growth of horn starts from the periphery of the injury, the diseased and displaced papillae are gradually brought into position by the growth of neighbouring horn tubules; and as repair proceeds, the normal state is restored. Sometimes the growth of horn is irregular, because it sets in before swelling has completely disappeared, and the papillae are unable to take up their normal position; or, again, horn production does not proceed regularly from the periphery towards the centre of the injury. The displaced papillae then become fixed in their abnormal position, and produce a horny prominence on the coronet, in consequence of certain of them not contributing to the formation of the wall, but producing independent masses of horn. The horny wall then shows a defect at the point in question, which detracts from its solidity. Sometimes the exterior of the wall is thickened, because horn formation

goes on while the coronet is still swollen. In exceptional cases, this thickening may take place on the inner surface, producing a horn tumour.

In addition to such complications, more dangerous consequences may follow treads. If, for instance, in consequence of direct injury to the joint, or its infection during an attack of purulent cellulitis in the subcoronary connective tissue, or of extension of necrosis towards the depths, purulent inflammation attacks the pedal-joint, the condition becomes incurable.

Necrosis of the extensor pedis tendon produces severe lameness ; when the foot is extended, or attempts are made to bear weight on it, the lower part of the limb assumes a position of excessive volar flexion. The condition, however, may involve no permanent injury, the defect in the tendon being replaced by connective tissue, which firmly unites the ends. Extension of necrosis to the sensitive laminae is dangerous, because of its tendency to involve large areas, leading to diffuse inflammation of the sensitive structures, which may be followed by loss of the hoof. Necrosis of the lateral cartilage always produces quittor.

Prognosis. The consequences of treads may be exceedingly varied. The following points are of chief importance :—

(1) The position and extent of injury. The more nearly the injury approaches the coronary band, the graver it becomes. If the skin and upper part of the horny wall are alone injured, and the wound is not deep, healing soon follows ; but treads on the coronary band not only offer great obstacles to treatment, but may involve the pedal-joint, especially in the small, clean feet of well-bred horses. At the centre of the toe the pedal-joint lies scarcely more than $\frac{3}{4}$ of an inch below the coronary border of the horn, but as we pass back it recedes from the coronet, and is therefore less easily injured. For this reason, and also because of the danger of injury to the extensor pedis tendon, injuries at the front are always more dangerous than those at the side of the foot.

(2) The size of the swelling and degree of lameness. As probing gives no reliable information of the extent of the injury, and may produce perforation of the pedal-joint, or introduce infective substances into the depths of the wound, in forming a prognosis, the amount of swelling and pain must be considered. Particular reticence should be observed when the parts are exceedingly painful but swelling is limited, especially if the pain is without visible cause. The general condition, appetite, temperature, &c., must, of course, not be neglected in forming a prognosis.

Diagnosis is rarely difficult, though in horses with long hair about the feet some little care is required to discover the injury. When necrosis sets in it may be doubtful whether the original injury was a tread, or whether we have to deal with a case of spontaneous necrosis. Brushing, and similar injuries, produce wounds resembling those caused by treads both in course and consequences.

Treatment. The first and most important precaution is to clean and disinfect the bruise. The hair which has been thrust into it by the heels of the other shoe, and infective material which is always introduced, should as far as possible be removed. The surrounding hair is clipped away, and any loose shreds of dead tissue excised. The entire foot, particularly the coronet, is then washed and the wound soaked with carbolic solution, or, if time allow, the foot may be immersed in a bath of antiseptic solution. The wound may also be sponged out or injected with a 10 per cent. solution of chloride of zinc. If the coronary band be much swollen, the horn should be rasped away over an area corresponding to the swelling before the final dressing is applied. Moist carbolic or sublimate dressings are preferable, and after the wound has been dusted with iodoform, a mass of tow, moistened with a disinfectant, is applied, the whole being covered with several large tampons of oakum, which are held in position by bandages. Excessive pressure must be avoided. If the dressing be too tightly applied, it not only increases pain, but favours necrosis in the region of the coronet. Once the dressing is applied, it can be kept moist by pouring over it several times a day a disinfecting fluid. If pain diminishes and the dressing is not saturated with discharge, the latter may be left in position for two or three days, otherwise it should at once be renewed. Should supuration occur, the moist dressing should be replaced by a dry one.

Particular care is required during cicatrisation; horn formation at the coronet should be discouraged until all swelling has disappeared. Should it occur, the parts may be moistened with a .5 per cent. caustic potash or soap solution, which will check the hardening of the new horn until inflammatory swellings disappear. Irregular cicatrisation must be treated in a similar way.

Very little can be done to prevent abnormal growth of horn on the coronet. If such growth only affects a small area—if, for instance, the base is no bigger than a five-shilling piece—the newly-formed mass may be completely cut away, which will improve matters, and may possibly result in complete cure. This becomes necessary when the growth overhangs the wall, and, as is often the case, maintains chronic suppuration around its base. The entire base is cut away

and a dressing applied to check bleeding, which is sometimes severe, and may necessitate the use of the actual cautery.

The deferred complications which follow severe accidents like those due to an omnibus wheel passing over the coronet, must be combated as they arise. Deformity of the foot, the growth of large exostoses and lameness can be treated respectively by the use of the farrier's rasp and knife, by firing and by neurectomy.

Sub-coronary cellulitis. The abundant connective tissue underlying the coronary band is in intimate connection with the subcutaneous connective tissue of the coronary region, and is related below to the parachondrium, and through this to the fibro-fatty frog; it contains the coronary venous plexus.

Injuries to the coronet, like treads and brushing wounds, often lead to inflammatory infection of this connective tissue (cellulitis of the subcoronary connective tissue). As a rule, the disease is confined to one side of the hoof, but sometimes extends to the other, so that the swelling involves the entire coronet.

The condition is ushered in by swelling of the coronet, and is accompanied by great pain, especially when weight is placed on the foot. The lameness is in direct proportion to the swelling, and is usually so severe as to prevent the animal standing firmly on the foot. The lymph vessels above the hoof are sometimes swollen, though this cannot always be detected with certainty. Rotation of the phalanges causes much pain.

The disease shows a great resemblance to purulent inflammation of the pedal-joint, and the diagnosis may for a time appear doubtful. Lameness, appearing simultaneously with swelling, points to primary subcoronary cellulitis; in secondary cellulitis, due to purulent inflammation of the joint, the swelling is preceded by severe lameness. And further, while in primary cellulitis pain generally diminishes after discharge occurs, in purulent disease of the pedal-joint it persists.

The course of subcoronary cellulitis is usually unfavourable. Sometimes laminitis results from the animal continually standing on the other foot, or the patient dies from decubitus; sometimes the disease extends to the lateral cartilage and produces quittor, but not infrequently septic inflammation occurs in the coronary band, destroys extensive tracts of tissue, and leads to a fatal result. Purulent inflammation of the pedal-joint, produced by extension of the cellulitis, is a frequent complication. Its onset is characterised by increase of pain; and if inflammation had not previously extended beyond one-half of the hoof, by the swelling involving the entire

coronet; fever is a constant symptom, though in some cases it may even precede this condition.

The inflammation scarcely ever affects the plantar cushion, though it may attack the connective tissue above the coronet, producing necrosis at this point, and leading to chronic suppuration and sinus formation.

The prognosis is generally unfavourable, so that it is only advisable

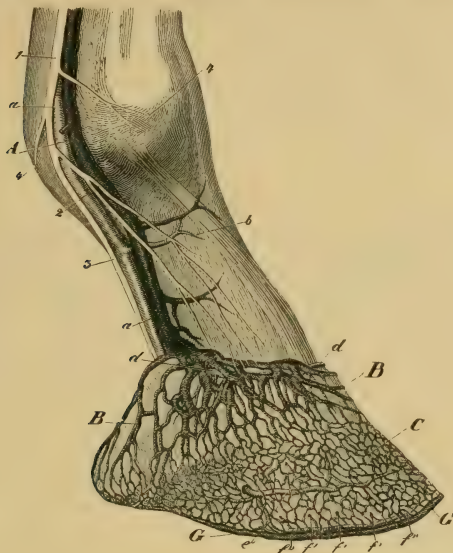


FIG. 565.—Lateral view of fore foot, with nerves and injected vessels, showing some of the structures involved in inflammation of the subcoronary connective tissue and its complications. *a*, Digital artery; *b*, perpendicular artery; *e'*, preplantar artery; *f'*, twigs from the plantar artery which escape through the foramina, just above the lower margin of the os pedis, and by their anastomosis form *f''*, the circumflex artery of the toe; *A*, digital vein; *B*, coronary venous plexus; *C*, laminal plexus; *G*, circumflex vein; 1, digital nerve; 2, anterior terminal branches of digital nerve; 3, posterior terminal branches of digital nerve; 4, cutaneous branches.

to treat animals of considerable value. On the other hand, recovery is not impossible, even when pain is severe, for sudden improvement sometimes occurs when the abscesses break.

Treatment. To prevent complications, all injuries of the coronet and its neighbourhood in which the skin is perforated, should if possible be treated antiseptically. Surface injuries are rarely dangerous. Treads on the coronet, especially when near the hoof, require particular care to avoid purulent inflammation.

If cellulitis has already appeared, dispersal will be favoured by warm baths, to which it is well to add some antiseptic. The appearance of distinct fluctuation should be the sign for immediately opening the abscess, though considerable bleeding must be expected, and almost always occurs. After discharge of the pus, the cavity should be washed out with a disinfectant, and tampons inserted to check bleeding. The tampons can be kept in position for twenty-four hours by a bandage, the pressure of which will increase their styptic action, but care must be taken not to apply it so tightly as to produce necrosis. For the next few days the abscess cavity must be repeatedly and carefully syringed with disinfectants, and precautions taken against retention of pus; a drainage-tube may be necessary.

IV.—CORNS.

THE name "corn" is applied to the effects of bruising or compression of the keratogenous membrane of the posterior portions of the foot. As a rule, the injury has its seat in the sensitive sole between the bar and wall, but sometimes the sensitive laminae of the bars are affected. Three varieties, dry, moist, and suppurating corn, were described by Girard, whose classification of corns is still recognised in practice.

Dry corn consists in capillary hæmorrhage at the inner surface of the horn, resulting from bruising or compression of the sensitive membrane. Moist corn is marked by exudation arising from limited pododermatitis, which may be superficial or deep; and suppurating corn represents an advanced stage of the first or second condition, in which the injured part has become infected with pyogenic and other bacteria.

The blood in most cases is extravasated between the sensitive villi or papillæ and the hoof, the inner surface of which it saturates, imparting to the newly-formed horn-cells a red colour (ecchymosis). The red spots thus formed sometimes appear as fine points if bleeding be confined to isolated papillæ, but generally as large red stains, which are only seen later when cutting out the foot—that is, after the coloured layers of horn have reached the wearing or ground surface of the hoof. With the age of the corn, the stain varies in colour and in depth. The more superficial the stain the older the corn. Deep staining indicates recent bruising, and when the whole thickness of the horn is ecchymosed the extravasation must have continued for some time. The colour of the stain may be bright red, dark red, black, or yellow, and when bruising has been repeated

at intervals, the corn may appear stratified—layers of ecchymosed horn alternating with unstained horn.

Causes. The fact that the posterior parts of the hoof are oftenest the seat of mechanical lesions is partly due to their greater mobility ; the movement of the hoof is most apparent at this point, and rupture of soft structures, therefore, more liable to occur. Then again, the heels carry a larger proportion of the weight, and the horn covering them is weakest. The more frequent occurrence of corns in the inner heel and in fore feet must also be referred to the greater weight borne and the more marked impact during rapid movement.

Corns are favoured by long, weak fetlocks, and by defects in

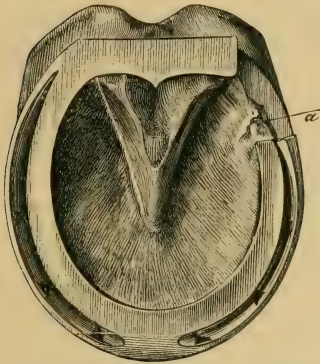


FIG. 566.—Three-quarter bar shoe.
a, Seat of the corn.

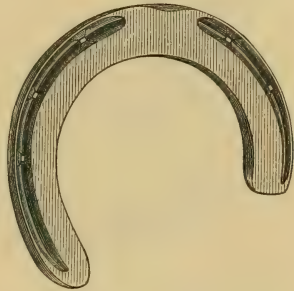


FIG. 567.—Ordinary three-quarter shoe.

formation, especially in the front limbs. In animals which stand with the feet well apart, the inner heel is most generally affected ; in the opposite conformation, the outer. Wide, flat feet with thin, low heels are particularly exposed to bruising from pressure of the shoe or from rough ground. The weaker the horn of the heels, the more readily do such injuries occur : rings on the surface of the heels suggest the existence of corns. Abnormally narrow feet are generally affected with corns, and in contracted heels they are almost always present. But wide hoofs are also liable to them ; in such case the corn being an injury of the sole, whilst in narrow hoofs the bar is more often affected.

The principal external causes are faulty shoeing, especially improper paring, the use of too short or too narrow shoes, or allowing the shoes to remain on for too long a time. As corns are very rare

in unshod feet, the idea obtained currency that they were always produced by the pressure of the shoe. For this reason farriers often endeavour to prevent the injury by rasping away the inner wall, so that it no longer touches the shoe. The result shows, however, that this idea is erroneous, for corns occur just the same, and, in addition, a sand-crack often forms at the coronet. It therefore seems clear that the heel should be supported by the shoe; if not, it descends,

and leads to rupture of the sensitive laminae. The attempt to remedy the evil thus leads to its propagation.

Prognosis. Although corns are so common that their absence in animals working in large towns is almost an exception, yet they give rise to much trouble. Severe consequences, however, only follow when the point of origin becomes infected; and as infection almost always takes place from without, it is of the greatest importance to protect the bruised spot against the entrance of bacteria. Sometimes, however, the horn is so defective that no precautions seem sufficient to prevent repeated bruising, and then the animals suffer habitually, and little hope of cure can be given.

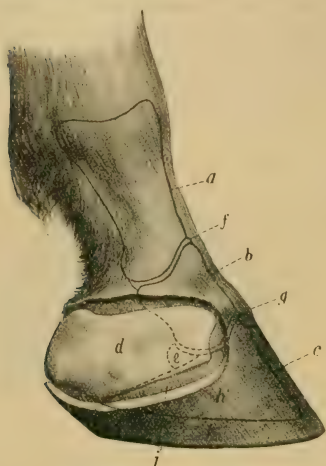


FIG. 568.—Showing the lateral cartilage and its relations. *a*, Os suffraginis; *b*, os coronæ; *c*, os pedis; *d*, lateral cartilage; *e*, os naviculare; *f*, pastern-joint; *g*, coronet-joint; *h*, horny wall; *i*, sensitive laminae.

Suppuration, when once established, may be followed by any of the above-described complications, especially in cases of deep pododermatitis. Swelling of the coronet points to the later appearance of quittor, whilst severe lameness, pain on dorsal flexion of the toe, and swelling between the bulbs of the heel suggest purulent suppuration of the fibro-fatty frog and infection of the flexor pedis perforans aponeurosis.

Bad conformation and work on stone-paved streets naturally lessen the chances of complete recovery.

Treatment follows the principles above indicated (see treatment of "Acute Inflammation of the Podophylloous Membrane"). The immediate cause must if possible be removed, and the shoeing receive

attention. For horses with flat feet, the shoe should be fitted long at the heels and should have broad branches. After recent suppurating corn a bar-shoe may advantageously be applied. On the other hand, horses with high, "blocky" feet often go better in "tips," Charlier shoes, or shoes with thin heels, provided no active inflammation exist. The regulation shoe for corn, employed by the great *Compagnie des Omnibus de Paris*, is a three-quarter shoe, the branch of the shoe being cut away on the side corresponding to the injury. Since adopting it the number of cases of corn has greatly diminished. During a period of sixteen months, only 44 cases of corn were reported amongst 15,500 horses in regular work.

In dry corn nothing further is required. Paring out corns is undesirable, and even injurious, because, after removal of the reddened layers of horn, the sensitive tissues are often exposed, and entrance of infective material facilitated.

For moist corn, antiseptic-astringent dry dressings are indicated. The spongy horn should be removed, the wound carefully disinfected and protected by an antiseptic dressing applied with moderate pressure. This treatment should be renewed daily until all moisture has disappeared from the wound.

In suppurating corn, free exit must be provided for the pus, which otherwise may accumulate beneath the sole. Infection rapidly extends and pus may soon appear at the quarter between hair and hoof, or at the bulb of the frog. If necrosis have occurred, the dead tissue should be removed as early as possible, and the spread of infection checked, antiseptics being employed either to destroy or hinder the development of bacteria. (For a detailed account of the various methods of shoeing horses with corns, see Dollar and Wheatley's "Horse-shoeing and the Horse's Foot.")

V. —QUITTOR.

THE name "quittor" is applied to necrosis of the lateral cartilage associated with chronic, purulent inflammation of the surrounding tissues and the formation of sinuses. The cartilaginous prolongations of the wings of the *os pedis* are surrounded by a firm connective tissue, provided with many elastic fibres, termed the "parachondrium," which is continuous with the subcoronary connective tissue and the plantar cushion.

Suppuration in the parachondrium is always liable to be followed by necrosis of the cartilage; and, owing to the difficulty with which the dead portions separate the process is obstinate, and the sinuses

through which the discharge escapes are extremely difficult to heal. From time to time the inflammation becomes more intense, and leads to destruction of further portions of cartilage, so that, unless energetic treatment be resorted to, the condition usually continues three to five months.

A similar affection occurs in the subcoronary and subcutaneous connective tissue at the coronet, and has been termed "côronary fistula." In the same way the French discriminate between "*Javart cutané*" and "*Javart cartilagineux*."

The process is caused by infection of the connective tissue with bacteria (staphylococci, necrosis bacillus). Sometimes the organisms enter through the skin, as in treads, in gangrenous dermatitis, and similar diseases, but direct injury of the lateral cartilage is a rare cause of quittor formation if the wound be at once properly treated, and in by far the majority of cases the condition has its origin in suppurating corns, or nail punctures. The infective inflammation thus excited extends to the connective tissue lying above the sensitive sole, or a crack forms in the horn of the wall, in consequence of which the sensitive laminæ may become inflamed.

On examining the parts, the parachondrium is found to be thickened and infiltrated with larger or smaller abscesses, while portions of the surface of the cartilage are necrotic, some being still adherent, others completely separated; they are generally of a greenish colour.

The course of the disease is always chronic. Recovery generally occurs, though sometimes only after complete destruction of the cartilage, a process which takes three to five months. As a rule, quittor remains confined to one side of the hoof, *i.e.*, to one lateral cartilage, the inner cartilage being most frequently affected, because primary disease is commoner at this point. For a similar reason the destruction of cartilage commences at the posterior end and extends forwards. The necrotic fragment may separate partially, but, as a rule, it maintains connection with the healthy tissue in front, to which the process gradually extends. Nevertheless, spontaneous separation with recovery is possible when disease is limited to the posterior third of the cartilage. The cartilage so called is composed of two tissues: the superficial layer being truly cartilaginous, the deep fibrous. The cartilaginous layer is thickest in front. At the back it forms small plates, separated by septa of connective tissue, an arrangement which favours delimitation, inasmuch as these septa constitute boundaries at which necrosis is sometimes arrested.

Necrosis of the os pedis, suppuration of the pedal-joint, and cellulitis of the subcoronary connective tissue or fibro-fatty frog

sometimes occur as complications. The first only increases the duration of the process ; but inflammation of the pedal-joint generally proves fatal, whilst purulent inflammation of the fibro-fatty frog and of the subcoronary connective tissue are often the forerunners of other grave conditions (see foregoing section on "Picked-up Nails," &c.).

Symptoms. As purulent inflammation of the parachondrium is the starting-point of quittor, the first symptom is a diffuse swelling of the coronet and of the bulb of the heel. This inflammation may in rare instances result in resolution ; but generally an abscess forms, and discharges pus mixed with blood, after which the swelling partially disappears, leaving a sinus 1 to 2 inches in depth. After some time this closes up and a fresh swelling forms, which takes the same course. The process is repeated at varying intervals. Often there are several sinuses which communicate with one another. In old-standing cases the wall of the hoof is thrust outwards and the horn is ringed, while the coronet may show the scars of several old sinuses. The depth to which ring-formation has extended is an approximate guide to the age of the condition, if one bears in mind that the wear of the foot is about $\frac{3}{8}$ inch per month.

Lameness is not often very severe, and may be so slight as to allow the animals to continue at slow work. It bears no fixed relation to the seriousness of the disease. With each recurrence of inflammation, however, the pain increases, and, if the pedal-joint or fibro-fatty frog be implicated, it always becomes very marked, and then shows the peculiarities distinctive of disease in the regions named. As the synovial membrane of the pedal-joint is in close contact with the inner surface of the anterior portion of the cartilage, the pedal-joint is occasionally invaded—almost necessarily with fatal results. This termination would be more common but for the fact that the adjoining lateral ligaments usually become inflamed and thickened before necrosis actually extends to the cartilage in contact with the synovial dilatation.

Prognosis. It is very difficult to foretell the duration and probable results of quittor. As a rule, coronary sinuses heal more rapidly than those of the lateral cartilage. In consequence of the process generally extending from the posterior towards the anterior extremity of the cartilage, the chance of early recovery is greater the nearer the sinus lies to the posterior end and to the upper border of the cartilage ; absence of swelling in front of the sinus is a specially favourable symptom. Great swelling, severe lameness, abundance of discharge, and deep sinuses suggest a long continuance of the

disease and troublesome complications, though the opposite conditions do not necessarily guarantee the absence of serious changes. Quittor produced by cracks in the horn generally takes a very protracted course, being often due to necrosis of the os pedis. Generally, quittor is less serious in hind than in front feet, probably because the lateral cartilage in the hind foot is smaller, less dense, and more vascular than in the fore, and, therefore, exfoliation of the necrosed fragment is more readily effected.

Treatment. It is of primary importance to prevent infection of the parachondrium, and, therefore, especial attention must be given to the careful treatment of corns, cracks in the horn, and other diseases likely to produce parenchymatous inflammation of the sensitive structures in the posterior portions of the foot. The freest exit must be given to inflammatory products, and the centre of disease kept as clean as possible. Injuries to the coronet are similarly treated, especially when the lateral cartilage is injured. Bräuer cured an injury of the cartilage, consequent on a tread, by carefully cleansing the wound with sublimate solution, and applying a dressing of iodoform and starch in the proportion of 1 to 5. Even extensive injuries of the lateral cartilage may heal by primary intention.

If swelling of the parachondrium points to suppuration, the hoof must be kept soft, and a lukewarm foot-bath, containing a disinfectant, used to assist resolution. When pus has already formed, it must be afforded free exit. Although abscess-formation always entails a quittor, infection may sometimes be prevented extending to the cartilage by syringing out the abscess cavity with 10 per cent. chloride of zinc or other disinfectant. When this fails other methods of treatment can be resorted to, all of which, however, depend on immediately removing any necrotic tissue, giving free exit to discharges, and checking the growth of bacteria in the parachondrium. These comprise:—Injection with disinfectants. Liquor Villati has for many years enjoyed a wide reputation for this purpose. Williams recommends 10 per cent. solution of corrosive sublimate, to which a few drops of hydrochloric acid have been added to ensure complete solution. Carbolic acid has also been employed. In using these, the principal point is to bring them intimately into contact with the diseased membrane. For this reason it is best to first inject into the sinus, by means of a small syringe, some carbolic solution to, as far as possible, remove pus, a process which can be aided by gentle pressure. Then follows an injection with the active agent, which may be 10 per cent. chloride of zinc, or corrosive sub-

limate. To ensure the solution reaching the bottom of the sinus, the syringe should be provided with a long, thin nozzle.

The injections must be made daily, and continued until they cause considerable pain, when they are discontinued for a time and again resorted to until suppuration altogether ceases. Sometimes after a few days the swelling diminishes and pus ceases to be discharged, both favourable symptoms, as they point to commencing healing.

When the sinus is old, deep, or very oblique, it is advisable to make a counter-opening. The coronary band should not be divided. After thoroughly thinning the wall a grooved director is passed to the bottom of the sinus, the wall divided from without, a small piece of the wall removed, and a short length of gauze passed through the sinus and tied, to secure it in position. Sometimes two sinuses exist, and require the insertion of two drains. Winkler recently recommended spirituous sublimate solutions, followed at a later stage by acetate of lead, also dissolved in spirit.

Gamgee's mixture has again come into favour. It consists of sublimate 17 parts, acetate of lead 34 parts, spirit 136 parts, hydrochloric acid 2 parts. After clipping away the hair and enlarging the sinus, a dry dressing is applied. On the second or third day, and again on the fourth, fifth, and sixth, the parts are injected. From the seventh day onwards, the opening of the sinus on the coronet is only disinfected and a dressing applied. In a fortnight recovery is said to take place (Walter). Giesecke recommends a 5 to 20 per cent. solution of protargol. Some endeavour to destroy the sinus by inserting caustic crayons; others employ the actual cautery for the same purpose, a farrier's poker being made red hot and introduced into the sinus. The poker must be carefully used, and special precautions are required when inserting it at the forward end of the cartilage. Though sometimes successful neither of these methods is safe unless confined to quitters of the posterior half of the cartilage.

To diminish the pressure of the horny wall on the swollen parts, Giesecke recommends applying linseed poultices containing creolin, and afterwards removing the softened horn. The sinuses above the coronet are scraped out with the curette, injected with 8 per cent. solution of chloride of zinc, and finally a small mass of tow covered with sulphate of copper is introduced. This procedure may require to be repeated; after-treatment consists of injection with antiseptic fluids.

Lignières has recommended injections of "resinate of copper,"

introduced daily for three or four weeks. With this treatment he cured thirty-two cases, some very serious.

Some cases are rapidly cured by one or another of the above-described methods, but in others no treatment short of extirpation of the necrosed cartilage seems effective. It is exceedingly difficult exactly to indicate the necessary conditions for healing, and therefore for some years operation has been more and more practised. Although operation can only be recommended in really serious cases and after simpler methods have received careful trial, it nevertheless

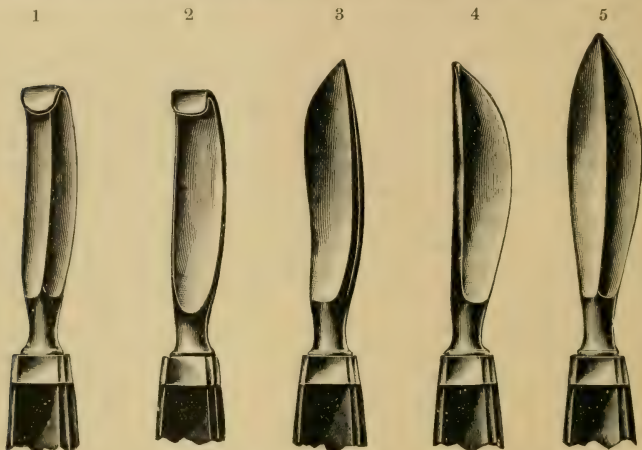


FIG. 569.—1 and 2, Double- and single-edged knives for thinning the horn; 3, 4, and 5, left-handed, right-handed and double-edged knives for removing the lateral cartilage in the operation for cartilaginous quittor. (French models.)

offers great general advantages, especially as regards shortening the course of the disease. If conditions are favourable to healing, operation should certainly be postponed, otherwise, and especially if careful after-treatment is possible, it should, on the contrary, at once be resorted to. Total extirpation of the cartilage is preferable to any partial measure, though, if the disease and swelling on the coronet be circumscribed, the latter may be tried. But even under these circumstances partial excision sometimes fails to arrest the disease, and complete extirpation becomes necessary.

Operation. After carefully cleansing and disinfecting the hoof, a portion of the horny wall, corresponding to the diseased cartilage, is rasped until thin enough to yield under the pressure of the thumb.

This avoids the necessity of stripping the wall, which is very painful. The parts are then soaked in sublimate, and if operation should not immediately follow, the hoof may be surrounded with wood-wool, and kept wet with sublimate solution for twenty-four hours.

The horse is cast and anæsthetised, and the diseased foot may be attached to the cannon bone of the diagonal upper limb or removed from the hobble and held extended. An Esmarch's bandage is then applied from the coronet to the knee, the dressing removed, and the foot rinsed with sublimate solution.

An incision is next made with a special curved knife (see Fig. 569),

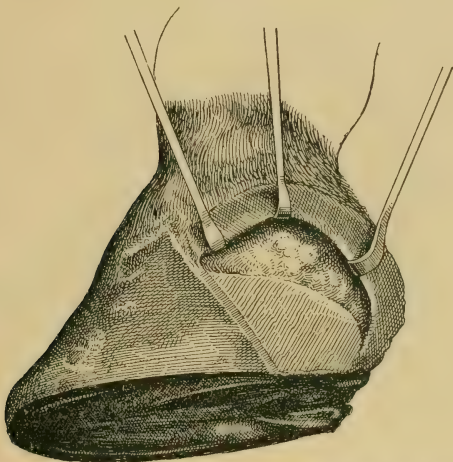


FIG. 570.—Operation for quittor. The whole of the lateral cartilage has been removed.

following the lower border of the coronary band, and corresponding to the size of the cartilage: any horn which has been left at this point is removed. The object of this incision is to separate the coronary band from the sensitive laminae, with which it is continuous. The incision should not at this stage extend beyond the inner surface of the coronary band, and particular care must be taken not to divide the band, especially near the bulb of the heel.

The edge of the coronary band is now drawn upwards with one or more retractors, and the double-edged knife passed cautiously in a perpendicular direction between the coronary band and the face of the cartilage so as to separate the two structures. Starting in the centre of the cartilage the operator first exposes the posterior,

then the anterior, portion of the cartilage. The knife should not wound either the coronary band or the cartilage.

The cartilage exposed, the operator seizes one of the single-edged knives, slides it into the wound with its cutting edge directed upwards and backwards, passes it behind the posterior extremity of the cartilage by executing a half turn of the instrument, and then with one stroke from within outwards, removes the posterior half of the cartilage, taking care not to injure the upper border of the sensitive



FIG. 571.—Celluloid injection preparation of the veins and arteries of the foot prepared by maceration. The veins are light in colour, the arteries dark.

membrane, which ought to be reflected. In some cases there is very little cartilage at this point to remove, the greater portion having become necrotic and been replaced by fibrous tissue, which should be spared.

This completed, the toe of the foot is, by means of a cord passed round the fetlock and hoof, extended as far as possible to facilitate removal of the anterior half of the cartilage. The knife is then held horizontally, its convex surface downwards, and the rest of the cartilage separated from underlying structures, and removed with forceps. By thrusting the finger under the coronary band, it is easy to discover whether portions of the cartilage have been left.

Any remaining should be removed with the curette, for on their complete removal depends much of the success of operation.

The wound is washed out with sublimate solution, again examined, and any loose shreds or particles of cartilage excised. The surface of the wound is then rubbed with 10 per cent. solution of zinc chloride, and after removing unhealthy granulations with the curette, the whole wound is douched with an antiseptic solution, the sensitive membrane replaced in position, and a dressing applied. French operators touch any "doubtful" spots with tincture of iodine. A couple of pads of gauze saturated with carbolic solution are placed under the coronary band to partially fill the cavity resulting from removal of the cartilage, and to check the bleeding which results after taking off the Esmarch's bandage. The hoof is then enveloped in carbolic jute or sublimate wood-wool, and a bandage firmly applied to bring the deep surfaces of the wound in contact and keep the dressing in place. This ends the operation, which is, of course, carried out under antiseptic precautions, the hands being properly cleansed, and the instruments disinfected. Bournay, Sendrail, and others do not approve of placing tampons under the coronary band. They consider that the tampons retard healing, and have no influence in maintaining the coronary band in proper position.

The first dressing remains in position twenty-four to forty-eight hours. After removing it the hoof is washed with a disinfectant, the wound freed from blood, again rinsed out, and a smaller gauze tampon inserted. The dressing is similar to that employed after operation, and need not be renewed for eight to ten days, provided fever be not marked, or pain severe, and the covering show no signs of becoming saturated with discharge. It is of particular importance that union should start from the base of the wound. Excessive granulations around the coronet are removed by astringents or caustics.

This treatment is continued until the coronary band is adherent to the underlying tissues throughout its entire length, *i.e.*, until the space between the divided coronary band and its foundation is completely obliterated. A tar dressing is then applied, the wound surface being smeared with tar, and a bandage saturated with the same material wound round the hoof. If pain be slight, a bar-shoe can be put on, and the horse sent to slow work. The time occupied up to this point is from three to six weeks, so that, as a rule, operation considerably shortens the duration of the disease. Siedamgrotzky's cases, on an average, occupied thirty-one days in healing. Many carriage-horses on which Möller operated recovered so perfectly

that not the slightest trace of operation could be detected on examining the hoof: and the animals themselves worked for years on the streets of Berlin.

Bayer has modified the above operation with the view of producing fewer and simpler incisions, facilitating the escape of discharge, and enabling the operator clearly to see each stage in the removal of the lateral cartilage.

On the day before casting, the horn covering the seat of operation is thoroughly thinned, the parts are freely scrubbed with a brush and disinfecting solution, and thereafter enveloped in several thicknesses of linen saturated with a strong disinfectant.

The horse is cast and the foot secured as previously described. General anæsthesia is desirable, but if local anæsthesia is preferred cocaine solution must be injected at several points around the coronet, and operation must be carried out more quickly than when chloroform is given. The hair is shaved from around the coronet and over the fetlock, and an Esmarch's bandage and tourniquet applied to the limb. The horn is then completely removed from the crescent-shaped surface beneath which lies the lateral cartilage (see Fig. 572). Instead of now lifting the coronary band, &c., from the surface of the lateral cartilage, Bayer makes an incision through the sensitive structures, corresponding with, but about $\frac{1}{4}$ inch within, the incision through the horn. The ends of this incision are prolonged upwards, dividing the coronary band, &c., as high as the upper margin of the lateral cartilage. The flap so outlined must now be carefully freed from the underlying lateral cartilage, which is next removed either wholly or in part, depending on the extent to which it is diseased. Sometimes the gouge or the chisel and mallet must be used to extirpate ossified portions of the cartilage. In the event of a large vessel being divided in the process it should, if possible, be ligatured. The fistulous opening on the coronet and any fistulous tracts must be freely curetted. After making quite sure that no necrotic fragments have been overlooked the parts are thoroughly cleansed with an active disinfectant and freely dusted with iodoform; the flap is then brought into position and secured with a series of interrupted sutures. Bayer endeavours to preserve all sound tissue, and therefore removes as little as possible from the coronet and, from the lateral cartilage, only diseased portions. It is quite certain, nevertheless, that disease processes in the cartilage extend very much farther than they appear to do, and that apparently sound portions are either in process of necrosis or very readily become infected after operation. Dollar, who has operated many times, prefers to remove the entire

cartilage, as the operation, though more severe, is less liable to troublesome complications, and is usually final.

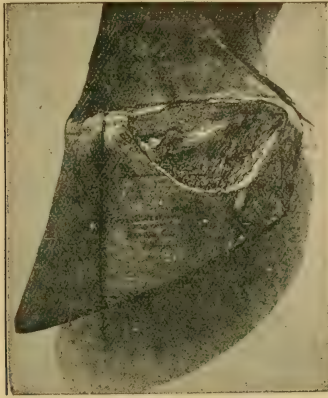


FIG. 572.—Bayer's operation (first stage).

After the whole field of operation has been disinfected the dressing is applied. It consists of four to eight thicknesses of iodoform gauze,



FIG. 573.—Bayer's operation (second stage).

enveloping and stretching well beyond the wound. Over this is arranged a pad of antiseptic jute, filling up the crescent-shaped

excavation in the horn, and pads of the same material are so adjusted as to bring the flap of skin and coronary substance into accurate



FIG. 574.—Bayer's operation (third stage).

contact with the tissues left after removal of the cartilage. A calico bandage secures the whole in place. To prevent displacing the flap



FIG. 575.—Bayer's operation (fourth stage).

the bandage should be applied from above downwards. The Esmarch bandage is only removed when the dressing has been securely fixed

in position. The latter usually becomes soaked with blood in a very short time, but this is of no importance, as the blood remains aseptic. A leather shoe or straw sandal is used to keep the parts clear of the ground.

Provided no great pain is shown and the dressing does not emit any unpleasant odour or discharge, it may be left in position as long as ten or twelve days. Increasing pain or offensive discharge necessitate a change. As, however, the second dressing can seldom be as complete or as accurately adjusted as the first, the change should only be made for good reason. This operation has given good results, and is worthy of trial in cases which prove intractable to injections or other treatment.

VI.—LAMINITIS. INFLAMMATION OF THE SENSITIVE LAMINÆ.

THE term laminitis is applied to a spontaneous, generalised aseptic inflammation of the keratogenous membrane, with more or less otitis of the os pedis. The lesions are always best marked in the anterior portions of the foot, where the inflammatory process is most intense; this localisation is probably due to the situation and disposition of the vessels of the plantar circle. Laminitis may be acute, sub-acute, or chronic. It usually affects the fore-feet, sometimes the hind-feet as well, but seldom these alone. In cattle the hind-feet are more frequently affected than the fore-feet.

The acute disease starts as a severe hyperæmia of the keratogenous membrane and os pedis, the sensitive laminæ being thickened and infiltrated and their adhesion to the horny laminæ weakened. Exudation soon follows, and, if the process is not arrested, its immediate effect is to loosen the connection between the hoof and its matrix, and as separation is favoured by the weight of the body, especially at the surface of the sensitive laminæ, the most extensive of the pathological changes occur at this point.

Within twenty-four hours after onset of the disease, the parts are much reddened and swollen, and proliferation of the young epithelium is taking place on the surface of the sensitive laminæ, which are covered especially in the region of the toe with a very slightly adherent, yellow fibrinous layer. Siedamgrotzky was perhaps the first to point out that the pressure of the body-weight, and the pull of the flexor pedis perforans tendon, tend to rotate the os pedis around its transverse axis, and so to cause the toe to sink and the wings to rise. A space more or less large is formed between the displaced os pedis and the horny wall, and in the chronic condition

the horny laminae become greatly increased in breadth. As the point of the os pedis moves downwards, the horn of the sole at the toe necessarily becomes flattened, and finally takes a convex form. This condition, in connection with certain changes in the horny wall, is termed "dropped sole." It was formerly assumed that the inflammatory growth pressed the os pedis downwards. Dominik insisted, on the other hand, that the horn of the toe was dislocated upwards, but that the os pedis remained in its normal position. Neither opinion harmonises with our present views, and to-day no doubt can exist that Siedamgrotzky's explanation is correct. The continuance of this abnormal form of hoof is dependent on the pressure of the ground against the toe of the hoof whilst the animal is moving. In dropped sole the wall of the toe close below the coronet appears abnormally perpendicular, but near the bearing surface takes a more horizontal direction, whilst the bearing surface itself is not only longer but also more oblique. This abnormal formation of hoof is identified with chronic laminitis.

Causes. Laminitis is most common in badly-formed, flat, and pointed feet. Its onset is favoured by mechanical irritation of the sensitive structures, resulting from severe work at high speed, long journeys, from continuous standing, as a result of painful lameness, from unskilful shoeing, &c. Rapid work, after prolonged confinement to the stable, is a very common cause of the disease. Laminitis is also very common during and after long sea voyages, as animals can seldom be exercised when in transit, and their digestive system is very apt to become disordered. Chill increases the tendency to the disease, which is therefore more frequent at the time of shedding the coat, after exposure to wet, or after long rest. The external causes comprise errors of diet and chill. Heavy foods, like rye, wheat, and barley, especially when given new, are particularly dangerous; but new oats and new hay also produce laminitis. At present it is not quite clear how such foods act, but the fact that boiling and steaming seem to diminish the injurious effect, points to the action of a toxin, and contradicts the view that the attack depends on the quantity of normally-digested material which enters the circulation at any one time. Such foods are particularly dangerous to animals which are unaccustomed to them, and which work little. Chills, either from sudden cooling of the body after sweating, or from the consumption of large quantities of cold water, also favour the production of the disease. Finally, laminitis (hæmatogenous or metastatic) occurs as a complication of colic, during convalescence from influenza, pneumonia, pleurisy, muscular rheumatism, and

infectious disease, or after difficult parturition, and as a sequel of superpurgation. Imminger, who states that about 1 per cent. of mares become affected with "parturition laminitis," considers the disease due to toxic substances produced in the retained lochia. It is commonest after abortion or difficult delivery, and is then very dangerous. He says, however, that the feet seem to suffer less than the muscles.

Symptoms and course. At first, the symptoms may be indefinite, sometimes pointing to disease of the chest or abdomen, the horse appearing dull, with arched back, stiff loins, irregular surface temperature or slight rigors, and feeding indifferently. But when acute congestion of the feet has set in the horse is found blowing, sweating in patches, with a full, bounding pulse (60 to 80), and a fever temperature (104° to 106° Fah.). The conjunctivæ are injected, the bowels constipated or relaxed, the mouth is hot and dry, and urine passed in small quantity. The affected feet are hot, very sensitive to light percussion, and the digital arteries can be felt, sometimes seen, strongly pulsating. The horse is not inclined to move, even forwards, though when forced, he lifts each fore-foot alternately, frequently tapping the litter before advancing. After a few steps he moves with less hesitation and soon improves in action. Laminitis of the fore-feet is generally shown by the horse "drawing" the fore-feet when set back, or by his attempts to avoid placing weight on the fore limbs, which are thrust forward, the feet resting on the heels, and the hind feet carried forward to take a greater share of the load and to relieve the front feet. The horse refuses to assist in raising a fore-foot; and when turned he "pivots" on the hind feet, the front feet being advanced as far as possible and the heels first brought in contact with the ground.

In laminitis of the hind feet the horse thrusts the front feet as far backwards, under the body, as possible, and, in order to relieve the toes of weight, brings the hind feet forward to rest on the heels. Thus he stands "bunched up," with the head and neck carried low, and if forced to move sometimes lifts the hind legs convulsively. When in a stall or box, he generally rests the hind-quarters against the wall, and in severe cases will endeavour still further to relieve the hind feet of weight by passing his head over the side of the stall, and hanging back from it by his head. If both the hind feet and front feet are affected, movement of any kind is exceedingly painful. The animals can scarcely be got out of the stable, and groan when forced to move. Although the disease is so painful, horses usually stand until exhausted. Once having lain down, however, they only

rise with great reluctance and a vast show of precaution, and when again on their feet usually exhibit acute pain for a time.

The severe pain sometimes forces the animal to lie continuously, causing extensive bedsores, which may lead to the destruction of the patient. In other cases, the os pedis perforates the horny sole, septic inflammation of the sensitive structures of the foot sets in, pain increases enormously, the animal is unable to stand, and death occurs from exhaustion.

In favourable cases the symptoms gradually decline and disappear in from four or five to twelve days, but often the feet continue more or less painful, though otherwise the patient may be out of danger. Sometimes normal action is not regained before the end of a period of rest extending from six or eight weeks to three months.

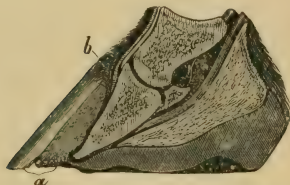


FIG. 576.—Longitudinal section of hoof three months after attack. *a*, Pathologically modified horn of the white line; *b*, distortion of the horn tubules in consequence of sinking of the os pedis.

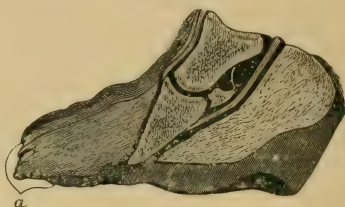


FIG. 577.—Longitudinal section of hoof one year after severe attack of laminitis.

Displacement of the os pedis can be detected by the falling-in round the coronet and depression of the sole. Once this has occurred complete recovery is no longer possible; the soles “drop,” and the animal ceases to be useful for work on stones or at a rapid pace.

Horses with dropped soles exhibit a peculiar gait: the os pedis being partly rotated around its transverse axis causes relaxation of the flexor pedis perforans; every time the animal extends the limb, therefore, the coronet-joint shows abnormal dorsal flexion, in consequence of which the heels come first to the ground.

Differential diagnosis. The following are some of the conditions which most closely simulate laminitis:—

(1) Bruising of the sole in unshod horses; this is detected by an examination of the foot.

(2) Muscular rheumatism. In this case the animal sometimes moves as in laminitis; the step is short and cautious, but the front limbs

are not extended, and while symptoms of inflammation of the foot are wanting, the muscles of the limb seem in a state of abnormal tension, and are painful on pressure.

Prognosis. The consequences depend partly on the severity of the attack, partly on the stage at which treatment is resorted to, and partly on the formation of the hoof and the character of the complications. The intensity of the disease varies greatly; it may be fairly estimated by the degree of pain. Prognosis is less favourable when the hoofs are already deformed, and especially when the soles are dropped. Cases following errors in diet are less favourable than those of rheumatic origin; and when all four feet are attacked, there is less hope of recovery than when the front feet alone are implicated. Finally, heavy-bodied horses suffer more severely than lighter animals.

Laminitis may terminate by resolution, or, owing to structural changes within the hoofs, the disease may pass into the chronic condition. The chief complications are hæmorrhage, suppuration, and necrosis.

To ensure resolution, treatment must be adopted within the first twenty-four to forty-eight hours. In this case recovery is generally complete in five or six days, though it should not be forgotten that for weeks after the disappearance of symptoms the tendency to fresh attacks continues, and therefore relapses are exceedingly common. Hæmorrhage usually occurs on the second or third day, seldom later in the acute disease. It is due not only to the intense congestion of the keratogenous membrane but also to the effect of traction on the sensitive laminae by the descending os pedis. Blood accumulates between the horny and sensitive laminae, and sometimes oozes at the heels, coronet, and white line. The occurrence of hæmorrhage is accompanied by marked aggravation of symptoms, the patient is exceedingly restless, blowing, sweating, and in great pain; the hoof becomes detached at the coronet, and death may result. Suppuration is less common; infection may follow excessive paring of the sole, or venesection at the toe. Frequently suppuration is limited to a portion of the sensitive sole, and the existence of pus may only be discovered during convalescence. In some cases suppuration involves the greater part of the keratogenous membrane, pus appears at the coronet and the hoof may be cast off. Necrosis or gangrene is nearly always secondary to infection and suppuration of the foot. The onset of this complication may be accompanied by slight remission of symptoms, but the apparent improvement in the animal's condition is quickly followed by great prostration,

with profuse sweating, cold limbs and clammy mouth, small thready pulse, sub-normal temperature, and death within forty-eight hours.

Chronic laminitis may be considered established if after the end of the second week there is not distinct improvement in the patient's condition. Gradually and permanently the hoof becomes more or less deformed, being greatly increased in length and flattened from above downwards. The wall, thick and bulging at the toe, is depressed or almost concave below the coronet; the sole is thin, flat or convex, the heels are exceptionally strong, and the surface of the wall is marked by ribs or "rings," which, running from one heel to the other, are approximated at the depression of the toe-wall, and irregular or broken at the quarters. The horn, especially the lower portions, is altered in quality, being dry, brittle, porous, and easily fractured, and is usually recognised as pumiced-hoof. In movement the horse goes on his heels, tilting the toes, his action closely resembling that seen in lameness arising from pyramidal disease (low ringbone), horn tumour and toe-sandcrack.

Treatment. As a preventive, all horses not in active work should be exercised daily, and should be placed on reduced diet, while attention should be given to the state of the bowels. Young horses should neither be over-worked nor over-fed especially with highly nitrogenous food. Horses just landed from a long sea voyage should be placed in loose boxes, and fed sparingly on light, easily-digested food. They should not be exercised for a week or so, as even a short journey is apt to precipitate an attack. From the earliest times laminitis has been treated by free bleeding, which, in fact, is useful if early resorted to. During the first three days bleeding from the jugular almost always produces rapid diminution of pain and inflammation. It is especially useful in cases following dietetic mischief, but is also of advantage even in rheumatic laminitis. Local bleeding, either from the coronet or sole, is less effectual; and the production of a wound in the sole is dangerous, because it may become the starting-point of infection, or purulent inflammation. If, therefore, bleeding from the toe be resolved on, the parts should be treated antiseptically. Bleeding from the coronary plexus is not so dangerous, and scarification of the coronet has often been recommended. Some practitioners recommend abstracting five to six quarts of blood from the jugular and applying mustard plasters to the chest and sides of the thorax.

The second means of treatment consists in cold applications. Cold poultices may be applied to the feet, or the animal may be placed in running water. When pain is severe poultices deserve preference.

Foot-baths are only of use in mild cases, and it should not be forgotten that continued standing favours displacement of the os pedis, and, therefore, that it is preferable to allow the animals to lie, and to apply cold applications to the feet. Plenty of short straw bedding should be given, the animals being made as comfortable as possible. It is also advantageous to remove the shoes and place the horse on a soft bed, so as to oppose descent of the os pedis by distributing pressure over the sole. If, in acute attacks, the horse cannot be persuaded to lie down it should be cast.

To permit of expansion of the hyperæmic tissues and to diminish tension, Smith recommends dividing the horn wall at one or more points in its circumference by means of the knife or saw. This treatment is of doubtful value.

In "dietetic" laminitis a dose of physic may be given, both to

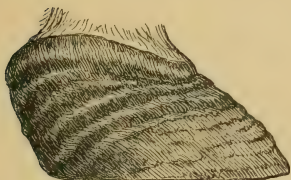


FIG. 578.—Hoof after laminitis.



FIG. 579.—The same shod. The dotted lines indicate the previous form.

diminish local inflammation and remove, as quickly as possible, any injurious material from the bowels, thus preventing its absorption. Others recommend the intravenous injection of barium chloride solution. In the rheumatic form the parts should be rubbed with spirituous solutions, and the body warmly clothed.

Friis recommended pilocarpine in doses of 5 to 7 grains. Experiments with this drug have given varying results; some cases showed improvement, others were unaffected. It may be tried, however, especially where the attack is obstinate, and the os pedis shows no sign of displacement; but after displacement, of course, neither this nor any other drug can effect a cure. Dollar has had excellent results from hypodermic injections of bromide of arecoline. Adrenalin solution injected subcutaneously at the fetlock or pastern has been recommended. To diminish severe pain, subcutaneous injections of morphine or cocaine are useful.

Regulation of diet is especially necessary, and when the attack has followed excessive feeding, the animals are put on short rations.

For the time being, corn should be completely withdrawn ; in summer grass can be given ; in winter, hay and bran-mashes.

It is now well recognised that, from the outset of the attack, exercise is useful, particularly in rheumatic laminitis. Sometimes the lameness occurs whilst resting during a journey ; and if the animal be started again, and pushed until it perspires freely, being afterwards carefully guarded against chill, it may completely recover. But, apart from the severe pain inseparable from this method of treatment, it may end in aggravation of the condition. The experiments made in the British army do not altogether recommend the treatment, though, under some circumstances, for example during field manœuvres, it may be useful.

Most cases after recovery are benefited by a rest of six weeks to two months in a strawyard or on grass, and before turning the animal out, the coronets should be blistered and the feet shod with light bar-shoes.

In chronic laminitis, the hoofs should be trimmed, shod with bar-shoes and leather soles, and the coronets blistered once or twice. To diminish the chronic congestion of the feet, ligation of the digital artery on one side of the limb has been recommended. The treatment of dropped sole and pumiced-foot pertains to the province of shoeing, and although the form of hoof may be improved, yet the animal's usefulness is never completely restored. As soon as acute inflammatory symptoms have disappeared, it is best to apply shoes with thick heels, and to promote the growth of the heels of the hoof as much as possible. (For fuller information on this point the reader is referred to Dollar and Wheatley's "Horse-shoeing and the Horse's Foot.")

VII.—KERATOMA.

THE horn forming the laminal sheath and horny laminae may become thickened, producing a tumour which is known as keraphyllocele, or keratoma. The growth is compact, semicylindrical, from $\frac{1}{8}$ inch to $\frac{3}{4}$ inch in thickness, and when fully formed may be pyramidal or conical with the base resting on the white line and the summit extending upwards, sometimes as far as the coronary border of the hoof. The upper extremity may be bifid, and occasionally the borders of the growth are irregular, constricted at certain points, and expanded at others. The base may be solid or fistulous, the channel limited to a short sinus, or extending through the whole length of the growth and opening on the surface of the adjoining sensitive laminae, from which a watery exudate passes down the

fistula. Sometimes the tumour presents outwardly a fissure which extends some distance into the substance of the hoof wall, which externally may be intact.

The activity of secretion in the coronary band is very great; in the sensitive laminae, on the other hand, it is very small, being only well marked at the upper part of the wall just below the coronary band itself, where the horny laminae originate. But when the sensitive laminae become the seat of chronic irritation, their latent horn-forming power becomes active, and a mass of new horn is produced.

Horn tumours sometimes start from the coronet, in consequence of treads or other injuries producing chronic inflammation and hyperplasia in the lower papillae of the coronary band. This pathological thickening gradually extends downwards towards the ground surface of the foot, and, pressing on sensitive structures, gives rise to chronic lameness. In other cases the sensitive laminae form the points of origin of the tumours. Laminal keratomata are usually confined to the lower portions of the wall, and though they extend upwards towards the coronet, they seldom reach it.

Keratomata therefore result from chronic irritation, or productive inflammation of the coronary band, or sensitive laminae. Sometimes the condition is followed by superficial suppuration. On the other hand, infective inflammation of the podophylloous membrane may constitute the first phase and be succeeded by a chronic productive process. Horn tumours produce atrophy of the plantar reticulum, sensitive laminae and os pedis. The bone presents a depression or gutter corresponding in form and dimensions to the tumour, and its edges are often studded with asperities or small bony growths resulting from superficial ostitis. The sensitive membrane lining the gutter is much reduced in thickness, or represented by a yellow fibrous layer with no trace of sensitive laminae.

Causes. Frequently keratomata are preceded or accompanied by complete sandcrack. Irritation of the sensitive membrane may be set up by a misdirected nail, by separation of the wall, cracks in the horn, by blows contracted during movement or from the hammer in laying clenches or clips, which may be too tight. Horn tumours may follow penetration of the white line by the clip of a displaced shoe, and in a hind foot it may be caused by forging. Fröhner, Cadiot, and Almy admit the possibility of the occurrence of spontaneous keratomata, which are sometimes met with in foals and yearlings that have never worn a shoe.

The symptoms vary with the position and size of the growth. Keratomata usually, but not always, produce lameness, which

exhibits all the symptoms of foot-lameness, except those of acute inflammation. When infection is absent and the keratoma is of small size there may be no lameness, which is usually due either to pressure of the new growth on the pedal bone or to inflammation.

Keratmata, derived from the sensitive laminae, frequently produce chronic inflammation of the latter. In such cases a secretion, which is sometimes watery, sometimes purulent, discharges from the space between the horny and sensitive laminae. A probe may often be passed to the upper margin of the split, *i.e.*, as far as the upper end of the keratoma.

Occasionally that portion of the external wall of the hoof corresponding to the keratoma is bulged outwards, forming a projection extending from the coronet to the bearing surface. This condition is commonest when the keratoma grows from the coronet; the

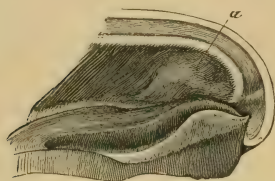


FIG. 580.—Portion of the inner surface of the wall showing changes after old-standing corn. *a*, Horn tumour.

surface of this protruding part is sometimes rough and inclined to split. In movement the toe is tilted, as in sandcrack lameness.

The diagnosis of keratoma during life can only be assured when the growth appears on the plantar surface of the foot. The peripheral border of the sole then presents an inset or a curve which partly encircles the base of the tumour.

Prognosis depends principally on the presence or absence of lameness, and on the possibility of removing the diseased growth. It is, therefore, important to know whether the keratoma has (1) originated in the coronary region, or (2) from the lower sections of the sensitive laminae. In the first case, its removal not only offers great difficulty, but enforces a long rest, as the hoof is divided to a considerable extent and a large amount of horn removed. In the second case, the time required for recovery is in proportion to the distance the diseased growth extends upwards. Keratmata, growing from the coronet, generally produce deformity of the outer surface of the wall, which is therefore an unfavourable sign. In many cases a new growth forms even after removal of the first, but this is not invariably the case.

Treatment. Unless the growth causes pain and lameness treatment is better abstained from. In shoeing, the portion of the wall below the tumour should be relieved of weight. Sometimes the lameness yields to rest and cold moist applications. Persistent lameness can

only be removed by excision of the keratoma or by neurectomy. The affected spot may be thinned with the rasp, and the keratoma removed by means of knife and forceps.

Fröhner and Gutenäcker divide the wall around the keratoma, remove the growth completely, and seek to assist healing of the operation wound by antiseptic precautions.

The great difficulty of this method is to determine the extent of the keratoma by examining the outer surface of the wall. To obviate this, the wall may be trephined and the extent of the growth ascertained by probing. The growth may also be removed by starting from the bearing surface of the wall and working upwards until its upper margin is reached. If the keratoma is small this concludes the operation. But when it is extensive and has produced inflammatory processes in the laminae and os pedis it may be necessary to excise the diseased laminae and to freely curette the bone.

The operation wound should be treated antiseptically. Complete recovery, however, is far from being the rule. The cavity in the os pedis may possibly be filled up again, but as the tendency to new growths exists in the sensitive laminae, and is not removed with removal of the keratoma, the disease not infrequently returns.

Similar growths occasionally affect the sole. They are commonest in flat or "dropped" feet. The tumour is usually hemispherical, the base intimately united to the velvety tissue of the sole. Treatment may be confined to paring the growth, applying poultices, and shoeing in leathers. Radical treatment necessitates opening the sole, fully exposing and excising the tumour, and is generally successful.

Considerable spaces sometimes form between the sensitive and horny laminae, whilst the surface of the sensitive laminae becomes covered with a thin, turbid, fluid secretion, and not infrequently granulations appear.

The process, described by Schleg as chronic ulceration of the sensitive laminae, is usually confined to a spot the size of a shilling in the lower parts of the sensitive wall. Sometimes, however, it extends upwards along the laminae, and may even reach the coronet, but there seems no tendency to penetrate more deeply. The chronic irritation around the diseased spot sometimes causes formation of keratomata.

The condition generally develops after acute inflammation caused by pricks, separation, or fissuring of the wall. Schleg saw the disease result from separation. Should the inflammatory centre become infected, healing is delayed, and the disease may become chronic. This is shown by the fact that after removal of the infected portion of wall and careful cleansing of the surface of the sensitive laminae, healing generally follows in three to four weeks.

Attention is first attracted by the lameness or escape of discharge through the white line during shoeing. The extent of diseased tissue can be detected by probing. Lameness is not a constant feature, but appears

immediately acute inflammation is set up by the entrance of infective substances.

The first step in treatment is to remove the wall covering the diseased spot by means of the rasp and knife without injuring the sensitive laminae ; it is, therefore, necessary to note accurately the point of division between the horny and vascular parts. After cleansing, as far as possible, the diseased laminae, they are painted with liquor ferri perchlor ; a mass of tow or jute, soaked with the same fluid, is applied, and secured by means of a bandage. If proliferation from the surface of the sensitive structures proves troublesome nitrate of lead may be employed ; Schleg used the actual cautery. The above-described dressing should then be applied and left in position for some days. When changing it, the parts are carefully examined, and if the wall has become further undermined the affected horn should at once be removed, but as a rule there is no marked tendency to extension.

VIII.—CANKER OF THE SOLE AND FROG (PODODERMATITIS CHRONICA VERRUCOSA VEL MIGRANS).

SINCE olden times, a chronic inflammatory hypertrophic disease of the keratogenous membrane of the frog and sole, sometimes including the sensitive laminae, and showing a strong tendency to spread to fresh areas, has been recognised and described as canker. The disease consists essentially in chronic hypertrophy of the villi or papillae and proliferation in the reticulum of the keratogenous membrane ; the villi becoming enlarged and grouped in thin or thick masses, and the cellular elements of the rete undergoing active increase. Some of the villi appear atrophied, the others are irregularly hypertrophied, enlarged at the base, oedematous throughout, and divided at the summit into multiple secondary vesicular papillae, with distended or hydropic cells. The reticular tissue is infiltrated with a sero-cellular exudate, and the spaces between the groups of hypertrophied villi are filled with an offensive, dark, semi-fluid material. In canker, there is always partial or complete destruction of the horny sole and frog, and the affected portions of the villous membrane are constantly saturated with cell debris, pus, and serous fluid. True horn formation is prevented, the epithelium breaking down and producing a loosely attached greasy, caseous, grey layer, with a characteristic, very fœtid smell. As mentioned under "verrucose dermatitis," canker is identical in character with so-called grease, *i.e.*, it consists in a dermatitis verrucosa ; it has also been stated that either condition may produce the other, or that grease may cause canker, and canker grease. Both diseases are very obstinate.

Symptoms and course. The commencement of the attack is

generally overlooked. As a rule, a small raised patch first forms on the frog and produces a grey, greasy, offensive material. On removing the loose horn, the enlarged villi of the frog, which cause the breach, can be detected with the naked eye. Lameness is rare at first, a symptom of considerable diagnostic importance, for in acute inflammatory diseases, great pain and lameness are always present. Gradually, sometimes almost imperceptibly, the disease extends, attacking first the frog, then the sole and bars, passing from these to the wall, and sometimes reaching as high as the coronet; always making its way between the sensitive and horny structures, which it finally separates. The sensitive laminae become enlarged and converted into brush-like structures, which produce exuberant vegetations immediately the wall covering them is removed.

With the extension of the process to the bars and sole the hoof expands at the quarters, whilst the frog considerably enlarges. At this stage lameness is sometimes seen during movement, but this is probably due to loss of the horny covering and accidental injury, not to the diseased process. When the condition is neglected it continuously advances, until finally it affects the entire matrix, causing great deformity of the hoof.

Causes. The causes of canker are at present little understood, and opinions as to the nature of the disease vary greatly. The name is a very old one, and originated at a time when it was customary to describe many different disease processes, distinguished by their malignant character, by the same term. It has long been recognised that canker has no real relationship with carcinoma, and therefore, strictly speaking, the name is unjustifiable. The disease is commonest in animals of a lymphatic temperament, and is favoured by dirty, ill-drained stables, where animals stand continually on litter soiled with manure, and saturated with decomposing, ammoniacal urine. Canker is probably due to specific infection, as seems indicated both by its course and the manner in which it reacts to treatment, but the infection does not appear to be due to a single organism, but to several, which do not always agree in their method of action. Mégnin has described one which he terms *Keraphyton*. (The subject receives further attention in Dollar and Wheatley's book on "Horse-shoeing and the Horse's Foot.")

Prognosis. Although canker always takes a chronic course, yet it shows many variations which are of real importance in forming a prognosis. Under any circumstances the practitioner should be cautious in giving an opinion, though the greater number of cases recover. The more active the process in the rete tissue and papillae,

and the softer the material produced, the graver the case. The more extensive the disease and the greater the tendency to spread, the less the chance of recovery. Treatment is particularly difficult when the laminae are attacked, easier when the condition is confined to the frog and sole. Rapid extension is always an unfavourable sign. The most difficult cases are those in which a predisposition to the disease exists, as shown by several feet being affected.

Treatment. Perhaps in no other disease have so many drugs been tried as in canker. The selection of a proper remedy certainly plays a very important part in treatment, and only ranks second to the manner of applying it. Caustics, which destroy the excessive growths, together with astringents and disinfectants, appear most effective. Sublimate, chloride of zinc, carbolic acid, calomel, salicylic acid, camphor, iodine, and many others have in turn found supporters, but, as Haubner very truly said, there is no specific against canker.

In addition to local disinfection, it is necessary, firstly, to destroy the new growths on the papillae; and, secondly, to check proliferation in the reticular tissue. Success in the first case depends on the size of the new growths. Caustics, the actual cautery, or the knife may be employed; but, whatever the means selected, care must be taken to remove all diseased tissue. The hoof must be thoroughly thinned, every particle of undermined horn removed for a distance of $\frac{1}{2}$ an inch round the diseased area, the margins of which are easily recognised by the fact that the horn there is adherent to the sensitive membrane beneath. By using an Esmarch's bandage, bleeding may be entirely avoided, and the seat of operation kept continuously under observation. All fragments of diseased tissue should be removed with the knife or curette. This treatment has proved more successful than the use of caustics. Healthy tissue should naturally be spared, but not at the expense of leaving disease behind. The softness and yellow colour of the altered tissues enable them readily to be distinguished. The operation is concluded by applying a pressure dressing saturated with weak formalin solution. As considerable pain attends the above manipulation, chloroform or a large dose of morphine should be given. Next day the dressing is removed. The field of operation will then be found covered with a cheesy adherent material, which must be removed with the knife or curette, but *without wounding the sensitive structures beneath*. The parts are then redressed with dilute formalin or whatever agent has been chosen, and packed with wads of tow under a pressure bandage.

Amongst caustics, nitrate of lead, recommended by Pütz, perhaps stands first. When strewn over the diseased surface in the form of

powder, it forms a dry scab, checks extension of the growth, exerts an intense drying action, and checks proliferation and secretion in the reticular tissue. Sometimes the process starts again under the dry crust, which therefore requires to be carefully examined during the next few days. Acids, particularly fuming nitric acid, can also be used, but their application requires care, whilst their action is difficult to control and certainly not more satisfactory than that of nitrate of lead. Experiments with sulphuric acid in the treatment of grease suggest the advisability of trying it in canker. Formalin solution, on account of its caustic, antiseptic, and drying action, is of great value. Fröhner recommended the cautious use of the officinal 40 per cent. solution of formic aldehyde, applied with a brush. This, however, is much too energetic, and 5 to 10 per cent. or even weaker solutions are preferable; if necessary, their application can be repeated. Hell, who used formalin extensively, prefers the 5 per cent. solution, as he has seen severe results from using the 10 per cent. He applies the solution on tampons of tow. When the growth is not severe, and the secretion is alone troublesome, calomel, liquor ferri perchlor, 1 per cent.; chloride of zinc, 10 per cent.; tincture of iodine, tar, &c., may be tried. Each has at some time been strongly recommended. Whichever be employed, a pressure dressing is always necessary. The actual cautery has been used to destroy the diseased tissue and excite repair, but requires supplementing with some antiseptic or astringent.

As a rule, treatment is commenced by removing the horn, and, if the hoof be very dry and hard, by immersing the foot in a warm foot-bath. All undermined horn must be removed. This is a *sine quâ non* in treatment. The foot is then soaked in a disinfectant, such as carbolic, chloride of zinc, or sublimate solution. After one or two hours' immersion, and after repeatedly washing the diseased part whilst the foot is in the bath, the material selected is applied and a dressing put on. Next day this is renewed, and if the process have extended farther, the undermined horn is at once removed; otherwise, if the surface remain dry, a fresh dressing is applied.

At first the dressing is renewed daily. To check excessive proliferation, the parts are dressed with nitrate of lead, and a pressure dressing of tow tampons tightly applied. In disease of the frog, bars, and sole, a shoe provided with a removable iron covering, or a plaster cast, will be found exceedingly useful. To prepare the latter, the hoof is filled with freshly-prepared plaster of Paris, mixed with chopped tow or hemp, to render it less friable, and the whole allowed to harden. When applying it, the sole should be covered

with firm pledgets of tow, so as to press as equally as possible on the growing tissues. A well-made shoe fulfils the same purpose provided the tampons of tow are pressed firmly against the sole and frog by slips of hoop-iron inserted beneath the shoe. Even at a later stage, it is important to renew the dressing every two or three days at least, and to examine the condition of the hoof. Particular attention should be directed to the margins of the diseased spot, and to the dry scab; if only the slightest trace of grey, greasy material is present, it must at once be ascertained whether the process is not spreading in deeper-seated parts. When healing is well advanced, calomel forms a very valuable application. Malcolm ("Jour. Comp. Path." vol. iv.), has cured many cases, by stripping the foot of all loose or under-run horn, carefully cauterising the unhealthy membrane with the hot iron, disinfecting the exposed surface, and applying a dressing of equal parts of copper, iron, and zinc sulphates, mixed with strong carbolic acid and sufficient vaseline to form a paste. The dressing is covered with a pressure pad of tow held in position by a shoe with an iron or leather sole. He strongly advises the eradication of every particle of canker tissue, and places more reliance on the actual cautery than on solid or liquid caustics.

Mesnard claims to have had excellent results from applying a mixture of 4 parts carbide of calcium and 1 part each of neutral acetate of copper and iodide of starch. The hoof is prepared as for the treatment with nitrate of lead, and after drying is freely dusted with the above powder and a pressure dressing applied. The process is repeated daily.

Imminger has suggested a "radical operation," consisting in removing the velvety tissue of the sole or the sensitive laminae, where diseased. Whilst Imminger reserves this treatment for old-standing, severe cases, Eberlein practises it in every case, removing the tissue with the knife "as though dealing with a tumour." The wound is then irrigated with sublimate or creolin solution, strewed with pyoktanin, iodoform or thioform, and covered with a compress dressing of gauze and jute. If no severe symptoms appear, the first dressing is left in position for a fortnight and afterwards renewed every eight or ten days. After the first fortnight the surface granulates freely, and is surrounded by a margin of thin healthy horn, which gradually advances over the wound. In dressing, the parts are simply wiped and powdered with iodoform; any exuberant granulations are excised. Fröhner cured 12 out of 14 horses in this way. The average duration of the cases was 27 days. Eberlein considers this the most successful of the many modes of treatment.

The disease cannot be regarded as cured until every point is absolutely dry, and normal horn formation has again set in. In spite of all precautions, relapses are very common, and therefore, for some months after recovery, the affected part should be kept under observation, so as immediately to check fresh onsets. Disease of the bars is exceedingly troublesome. The sensitive structures of the bar being in contact with those of the frog, the vegetations coalesce, and render it extremely difficult completely to expose the diseased spot. It is necessary to excise the new growth, and insert pressure tampons between the two, a very small tampon being first thrust into the depths, and followed by others of increasing size, so that the dressing extends into the space between the bar and frog in the form of a firm wedge. Many observers recommend placing the horse during the day on a thick clay bed, and, after thoroughly cleaning the hoof, to use at night tan instead of straw. Although this method appears easy, its use is attended with many inconveniences. Apart from the necessity for daily cleansing and changing the bed, the clay becomes soiled with urine and fæces, and requires frequent renewal. By working the horse on a brickfield, the same effect is produced more easily and thoroughly, whilst the daily exercise assists recovery.

Such treatment is useful where the ground surface only of the hoof, *i.e.*, the frog, sole, and bars, is affected, but is valueless in disease of the wall. The sustained regular pressure on the new growth here plays the principal part. Recovery often follows this treatment.

A somewhat similar effect is produced by using the animal on soft ground, especially if shoes can be dispensed with. The process makes less rapid progress while the horse is at regular work than during rest—a fact to be borne in mind. Should all other treatment fail, the animal should, if possible, be exercised. The effect is sometimes astonishingly good.

Nocard some years ago recommended vigorous treatment with sublimate solution. After completely exposing and carefully cleansing the diseased spot, it is sprayed for two hours and a half with 1 per cent. sublimate solution. The sole is then dried, and its surface sprayed for ten minutes with iodoform ether. Nocard gave Fowler's solution inwardly to the extent of 10 drachms in eight days. Later reports by Nocard and others show, however, that even this treatment sometimes fails.

It need only be repeated that more is due to care in carrying out operative treatment and skill in applying the dressings than to the selection of the material. A change of dressing is desirable from time

to time, and the local treatment should be supplemented by internal medication with such materials as arsenic or the iodides. The use of caustics, or of the actual cautery, should not be pushed to excess, and when the discharge ceases it is better to replace them with milder applications and with disinfectants. Although the principles here set forth are sufficient to guide treatment, yet close personal observation is necessary, and in many cases it may appear advisable to try certain of the other remedies suggested.

G. DISEASES OF THE CLAWS IN CATTLE AND SHEEP.

Disease processes in the claws of ruminants show a general resemblance to diseases of the horse's hoof, though they exhibit many special features, dependent chiefly on the duplicate formation of the claws, and on other anatomical peculiarities.

The claw consists of a horny wall surmounted by a coronary band, and of a horny sole with bulbs similar to those of the horse's heel. These perform the function of the frog, which, with the bars, is absent in ruminants. In medium-sized cattle the horny wall attains, on its outer part, a thickness of about $\frac{3}{16}$ of an inch, whilst the inner, which lies in contact with its fellow, is scarcely $\frac{1}{8}$ of an inch, and is considerably shorter than the outer on account of the sole sloping obliquely upwards to become continuous with it.

The horny sole also has a thickness of about $\frac{3}{16}$ of an inch, and reaches from the toe to the posterior third of the ground surface of the claw, where it becomes continuous with the wall. Above the wall, and between it and the tendon of the flexor pedis perforans, is a mass of firm connective tissue, to some extent corresponding to the fibro-fatty frog, and containing a large quantity of fat.

The pedal-joint (Fig. 581) lies near the centre between the toe and ball of the foot, its middle point (*b*) being somewhat nearer to the toe than to the wall, and about $\frac{3}{4}$ of an inch below the coronary border of the wall. A straight line drawn obliquely from the front of the interdigital space to the termination of the horny sole in the walls would nearly coincide with the lower border of the joint (Figs. 581, 582). The posterior end of the os pedis lies between *c* and *d* in Figs. 581, 582, behind *c* lies the navicular bone, which completes the formation of the pedal-joint. The coronet-joint is generally about $\frac{3}{4}$ of an inch above the coronary border of the wall of the claw; the position of the fetlock can, of course, be determined by palpation.

The sensitive wall and coronary band differ little from the corresponding portions of the horse's hoof, though the band is broader, and reaches downwards almost to the middle of the horny wall. The sensitive sole presents a general resemblance to that of the horse, but the postero-internal portion possesses a modified subcutis somewhat analogous to the sensitive frog. The surface of the sole may be divided into toe and bulb, a fact which accounts for the severity of all suppurating processes in the bulbar portion. Between the claws the coronary band becomes continuous with the skin, which is hairless, and covered with a thick but slightly horny epidermis.

Above this, *i.e.*, between the coronet bones, lies a large pad of fat, which is continued downwards under the inner horn wall, and assists the movement of the claws over one another.

The bone of the claw (*os pedis*) is united to the coronet and fetlock bones by two internal and external ligaments, and through the former to the reinforcing band of the extensor pedis (*ligamentum extensorum*), whilst the cruciform or interdigital ligaments unite the two claws and prevent their being thrust too far asunder.

This peculiar structural arrangement renders cattle less suited for moving on hard ground, and, if they be forced to do so, predisposes the soft structures of the claws to injury. The distribution of weight in the claw is different from that in the hoof. Whilst in the hoof the wall supports the principal weight and the sole is practically exempt, the sole of the claw carries by far the greater portion of weight. The same is true even when the claws are shod, and it explains the frequent occurrence of bruises of the sole.

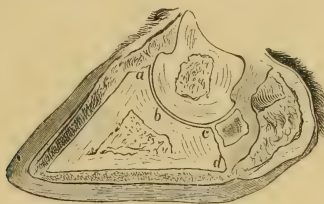


FIG. 581.—Vertical section of an ox's claw.

In these animals a local examination, although absolutely necessary for diagnosis, is very difficult to make. When the animal is standing it is sometimes possible to lift the foot, as in the horse, and thus to examine it. In restless or obstinate animals, a cord may be passed round the front fetlock, carried over the withers to the opposite side, and the front foot thus lifted. The hind foot can be lifted by passing a cord round the cannon, or by placing in front of the bend of the hock a strong twitch-stick by which two strong men raise the limb; the hind foot may also be drawn up to the shafts of a waggon and fastened. In any case, the animal must be firmly held by the head. When the animal is lying, there is less difficulty, but the limbs should be secured by means of cords.

The foot may be examined by pressing on and moving it. Any swelling, reddening of the neighbouring skin, wound about the claw, or discharge of pus should be noted. Both the coronet and skin of the interdigital space should be carefully examined, the foot being

first cleansed. Loose, overgrown horn should be removed with the knife, and any breach of the wall or sole carefully explored.

In cattle it is extremely difficult to use foot-baths, which, therefore, are of little practical value.

I.—BRUISES OF THE SENSITIVE SOLE AND BULBS OF THE FOOT IN OXEN.

IN the smaller ruminants the claws are exceedingly strong in comparison with the body-weight, and disease is correspondingly rarer than in oxen. In the latter, the claws of the hind feet are weaker than those of the fore, and therefore suffer most, while, of the two claws, the inner is the oftener affected.

The conditions comprised under the head of bruises vary greatly in character, some remaining aseptic and confined chiefly to the subcutaneous tissues, others being of an infective nature and followed by suppuration or necrosis. The latter may either remain confined to the superficial layers of the sensitive sole, or may extend as far even as the bone of the claw or the flexor tendon. Bruises of the superficial layers of the sensitive sole may be followed by bleeding, varying in amount from a trifling escape to an extravasation sufficient to undermine the entire sole. In the latter case a new sole may be formed, between which and the old sole the partially-absorbed blood forms a dark-coloured, dryish, friable cake, or, in older cases, a grey, fatty mass, corresponding in nature to the dark-coloured, liquid, horn "pus" seen in superficial injuries of the foot in horses. When the deeper layers of the sole are injured, violent inflammation often results, leading finally to necrosis. In the toe, thin pus is formed, and the bone of the claw becomes necrotic; in the bulbs severe cellulitis is set up, the flexor tendons become necrotic, and the pedal-joint is attacked. When the injury is still deeper seated, the skin, subcutis, tendons, and tendon sheaths often become inflamed, the process sometimes extending to the knee or hock-joint. The animals lie continuously, and die of exhaustion.

The primary cause of the above conditions is some mechanical injury, such as unequal distribution of weight in consequence of abnormal growth of the claws, softening of the sole in stalled oxen, or in unshod oxen working on wet ground, bruises resulting from driving fat oxen over rough roads, wearing away of the sole from long journeys, careless shoeing, or the accumulation of dirt between the claws. If, as is almost unavoidable in cattle, the injured tissue becomes infected, there is scarcely any limit to the possible complications.

Symptoms and course. The condition usually appears during a journey, the animals gradually becoming lame, the stride being shortened, and the animals showing a tendency to lie, and to move the feet uneasily when resting. When the inner claw is alone affected oxen often stand with crossed legs. Once in their stalls they at once lie down, refuse food, and show no inclination to rise. An examination of the claws shows that in one or more pain is produced by pressure over the sole and bulbs of the foot. In severe cases the horn of the sole when cut appears reddened, and suppuration may have occurred, with discharge of pus at the bulb or coronet; in other instances the sensitive sole, or even the bone, may be necrotic. The coronet is then greatly swollen, painful, and, if not pigmented, shows congestion. In the later stages fever sets in, the animals lie continually, groan, grind the teeth, and finally die of septicæmia. To ensure a proper diagnosis at an early stage the sole must be carefully thinned. When bruising is slight, and the animals are at once rested and placed on soft bedding, recovery follows in a few days, but in suppuration under the sole or bulbs there is danger of the animals dying from decubitus. The possibility of purulent inflammation and necrosis of the sensitive bulbs of the foot and underlying connective tissue constitutes a further danger. Such cases may be followed by purulent inflammation and necrosis of the perforans tendon, or be complicated with septic disease of the pedal-joint.

The prognosis must, therefore, be guided by the degree of pain and the existent changes. Necrosis of the tendon and purulent inflammation of the joint are dangerous, but not absolutely hopeless, recovery sometimes following amputation of the claw; where several claws, and especially when several feet, are simultaneously attacked, however, there is little chance of the animal surviving.

Treatment. Unless suppuration has set in, it is often sufficient to allow a few days' rest, and plenty of soft bedding; severe pain may be combated by cold applications; but when pus has formed, a free exit must be provided, though with as little destruction of the wall and sole as possible. The superficial form of inflammation exhibits the same peculiarities as in the horse, and a comparatively small opening is sufficient to allow the thin pus to escape. After carefully cleansing the claws and injecting undermined portions of horn, a dressing is applied, which by smearing with tar can be rendered waterproof, so as to guard against the diseased spot being soiled by manure, &c. Necrosis of the tendon or disease of the pedal-joint necessitates amputation of the claw.

II.—WOUNDS OF THE SOFT TISSUES OF THE CLAW.

ON account of the comparative thinness of the horny wall, the soft tissues of the claw are often wounded in shoeing. They may also be injured by picked-up nails, glass, splinters, or other foreign bodies penetrating the sole. Such wounds generally affect the posterior parts of the sole and the bulbs of the heel, and are therefore as dangerous in cattle as in horses, the perforans tendon and pedal-joint being readily injured in either; pricks in shoeing seldom injure more than the sensitive laminae. The toe may be injured when the hoof is shortened, the matrix or even the bone of the claw being injured by the knife or saw. In heavy draught the point of the toe sometimes breaks off or cracks across, and is pressed inwards, severely bruising the soft tissues. These facts should be borne in mind in forming the prognosis.

Symptoms. Lameness usually sets in suddenly. Sometimes it is only slight, sometimes severe. Before examination the claws must be thoroughly cleansed. When the flexor tendons are injured pain is acute, and little or no weight can be placed on the foot, while the animals show great pain on dorsal flexion of the claw. Implication of the joint is shown by excessive pain, especially on rotation of the claw, and by swelling of the coronet, most marked above the toe. Not infrequently purulent synovia is discharged.

Treatment requires the removal of any foreign body, cleansing of the injured spot, furnishing of a proper opening for discharge of pus (the above-mentioned precautions being borne in mind), and finally provision against infection. Clean, dry straw should be provided and a dressing applied. Injuries or secondary affections of the flexor tendons are treated on the lines laid down under panaritium.

III.—LAMINITIS IN OXEN.

WORKING oxen used on hard roads, and fat beasts which consume large quantities of highly-nutritious food, often suffer from a disease of the claws which closely resembles laminitis in horses. The hind-feet suffer more frequently than the fore, though the fore or, indeed, all four feet are occasionally attacked.

The disease is **caused** either by mechanical injury or by over-feeding.

The symptoms closely resemble those in the horse. In anterior laminitis the fore-feet are extended in front, resting on the points of the claws, the hind-feet being carried well forward. In posterior

laminitis the inner claw is chiefly affected, and the four feet are brought together under the body. The back is arched, the feet constantly shifting or "paddling"; rumination is suppressed; the animal refuses food, has a fever temperature, and is more or less constipated. Pain is evinced whether the animal merely stands or endeavours to walk. Emaciation is very rapid. The horn of the coronet seems to sink in, and the claws to separate from the bulbs of the heel. At a later stage suppuration occurs, the disease in this respect differing from laminitis in horses, and the pus may break through at the coronet or the horny claw may be shed.

As a rule, the attack terminates by resolution in eight to fifteen days; chronic cases sometimes occur, with deformity of the wall and sole, "ringing" of the wall, and increased horn formation at the white line. Shedding of the hoof may take place early or only towards the close of the attack, and is usually associated with suppuration and necrosis of the keratogenous membrane.

Treatment consists in absolute rest and local cold applications for working oxen. The diet should be light. When suppuration and loss of the hoof occur, they render the case so serious that treatment is seldom justifiable from an economic standpoint, and the animal should be slaughtered.

IV.—PANARITIUM, WHITLOW OF THE CLAW, PANARIS.

THE term "panaritium" is used to distinguish an acute inflammation, rapidly leading to suppuration, and always attended with necrosis, which in man occurs under the nail, in oxen appears at different parts of the claws, and extends thence to more distant points. The use of the word is quite justifiable, for in cattle the condition attacks the part homologous with the nail, and the process develops in just the same way as in man. Panaritium is due to wound infection, followed by cellulitis, which, partly in consequence of the action of the infecting agent, partly of the anatomical formation of the diseased parts, always tends to necrosis. In oxen the claws are exceedingly exposed to such infection. Being almost always surrounded by dirt, slight injuries of the skin, which are certainly not uncommon, at once open the way to infection, and this again often extends to deeper-seated structures. The process is, therefore, not confined to the skin, but extends to the subcutis, and not infrequently to the tendon sheaths, bones, and joints, producing conditions of the gravest character.

Being essentially due to infection, this disease sometimes extends very widely, appears more frequently in certain establishments,

and even becomes enzootic, while outbreaks are favoured both by neglect of cleanliness in the stalls and by travelling on hard ground. Schleg noted inflammation of the interdigital skin, which often led to necrosis in cows at grass during the autumn. Of twenty-eight animals which stood together, eight were attacked, whilst those standing on the other side of the stable entirely escaped. The exact cause of panaritium is yet unrecognised. According to Bang the disease is not caused by a specific agent, but by ordinary pyogenic organisms which have acquired a special virulence. Flügge's bacillus of necrosis is very often present, but it cannot with certainty be regarded as the sole causative agent.

(1) Panaris of the toe develops at the front of the interdigital space. An inflammatory swelling appears, without any visible external injury, involves the coronet and skin of the interdigital space, and may extend beyond. The condition consists of cellulitis of the cutis and subcutis, accompanied by necrosis, and may therefore be described as panaritium subcutaneum.

Inflammation often attacks the connective and adipose tissue lying above the interdigital space, and the tendons and ligaments of the pedal and coronet bones. The symptoms are then very severe; the swelling, redness, and pain are greater, scarcely any weight is placed on the foot, the swelling extends further backwards and downwards over the skin of the interdigital space, and fever, loss of appetite, stoppage of milk secretion, and general wasting ensue. The skin becomes necrotic, or an aperture forms, from which ichorous pus is discharged in large quantities. The symptoms then moderate, and recovery follows in about three weeks under appropriate treatment. This process might be described as panaritium profundum.

But if such an attack be improperly treated, or the infective material be particularly virulent, necrosis may extend to the coronet or pedal bone, or to one or other of the joints, and septic arthritis develop. Immediately a joint is attacked, the swelling extends to the cannon bone, though in disease of the pedal-joint, swelling is greatest around the interdigital space. The patient shows high fever, and the same symptoms as in panaritium profundum, but in an aggravated degree.

(2) Interdigital panaris consists in infective inflammation of the skin and deeper structures connecting the two claws, especially of the fatty tissue, which is so abundant in this region. It occurs oftenest when the claws are excessively separated, and when the oxen are worked, both of which conditions favour injury and infection of the interdigital skin. The skin between the two claws appears swollen,

and protrudes somewhat in the form of a snail—hence the origin of the French term “*Limace*.” Pain is marked, no weight can be borne on the foot, the animal lies continuously, and shows fever and loss of appetite. After a few days the skin between the claws breaks; sometimes the interdigital ligament is ruptured, and the swelling, increasing in size, causes the claws to recede from each other.

Appropriate and early treatment is generally followed by recovery, though in cases the process extends to the os coronæ or to the pedal-joint. As a rule, the latter danger is not so great as in panaritium of the toe, the pedal-joint not being so likely to become implicated from this point. Interdigital panaritium is not infrequently followed by extensive proliferation of connective tissue, which is readily injured and leads to fresh attacks of inflammation. The growth may, however, be readily removed by operation.

(3) Panaris of the bulb of the foot generally attacks the inner bulb of one of the front feet; sometimes both bulbs are attacked, very seldom the external alone. The cellular inflammation rarely confines itself to the sensitive parts of the bulb and to the connective and fatty tissue lying above them, but, as a rule, attacks the flexor tendons, and often the pedal-joint. Necrosis of the tendons sets in, with purulent or septic disease of their sheaths, at the point at which they pass over the navicular bone, for which reason this form might be described as panaritium tendineum.

The course depends on the character and extent of the disease. When the bulbs and the structures underlying them are alone implicated, recovery takes place in two to four weeks. In disease of the flexor tendons or pedal-joint, amputation is the only resource.

Treatment. Preventive treatment consists in keeping injuries as clean as possible, and preventing further infection by dressings or smearing the parts with tar, and by giving plenty of dry, clean straw as bedding. When a panaritium is detected, the inflammation has usually passed the stage at which resolution is possible, and efforts must be made to provide the best possible exit for pus and necrotic tissues. The most useful agent is certainly the knife, though in many cases it cannot at once be used, and the abscess must be assisted to point by warm poultices of linseed, &c., to which are added from 5 to 10 per cent. of some active disinfectant. In the early stages, indicated by slight reddening of the skin and shuffling with the feet, resolution sometimes follows the application of bandages saturated with sublimate or creolin solution. Fambach recommended the long-continued application of warm alum solution. As soon as an

abscess is discovered, and can be reached with the knife, it should be opened, the wound being antiseptically treated and washed out with 10 per cent. chloride of zinc solution, or injected with 3 per cent. of creolin. Esser recommends using the curette, washing out the parts with 5 per cent. carbolic solution, applying an iodoform dressing which is smeared with tar, and allowing it to remain in position for eight to ten days. To keep the horn soft, moist dressings are best. Necrotic tissue should, as far as possible, be removed with the knife and curette.

The opening of abscesses is least dangerous in interdigital panaritium, and Harms recommends completely dividing the skin between the claws, if it has not previously been ruptured. In panaritium of the bulb the bulbs themselves should be spared as much as possible; they should never be completely divided in the longitudinal direction of the claw, as their further growth would be interfered with. In panaritium of the toe the skin is divided perpendicularly, the diseased point laid open, and free exit given to discharges.

Dressing the parts calls for particular care. In panaritium of the toe and interdigital panaritium the space between the claws is filled with tow or jute, soaked in carbolic solution, to such an extent as to prevent the claws moving. Both claws are then included in one dressing and surrounded by a bandage or cloth rendered waterproof by a free use of tar.

As a rule, pain soon disappears after the abscess breaks or is punctured. The dressing may then be left in position for several days, but the above precautions should be taken when it is renewed. If granulation appears too free, astringents like sulphate of copper may be applied, or the parts can be dusted with dried alum.

Digital Dermatitis. In oxen, the skin at the front of the interdigital space sometimes becomes inflamed, but the process remains confined to the cutis, and pain is less severe than in panaritium of the toe, though healing is difficult on account of the inevitable movement of the claws. The skin appears somewhat swollen and painful, and an inflammatory discharge flows from the surface, which, in drying, produces crusts, while the coronary edge of the horn becomes locally separated. Neglect of these symptoms may be followed by the development of panaritium. The animals should therefore be placed on dry straw, the diseased spot carefully cleansed, powdered with iodoform, and a triangular piece of wood corresponding to the width of the interdigital space placed between the claws and fixed in position by strong tape passed round the claws. This prevents movement of the claws, which interferes with healing. To ensure the tape remaining in position, a couple of shallow grooves may be made with the knife or rasp around the lower part of the claws.

Vaeth suggests the use of chloride of zinc dissolved in water and made into a paste with an equal quantity of flour for treating inflammatory

new growths and warts in the skin of the interdigital space. The material is smeared on the diseased spot and a dressing applied over it. Vaeth treats warts by laying them open and rubbing in chloride of zinc, after which they fall off in a few days.

Canker. Delmer described, in oxen, a disease which resembles canker in horses. The sole of the left claw of the near fore foot was entirely lost, except near the bulb, where it was as thin as paper. The sensitive sole was studded with small, greasy-looking, stinking grey masses, showing an indistinct lamination. The sensitive sole below was swollen and bluish in colour; it bled readily. The papillæ, however, showed no tendency to exuberant granulation. Treatment consisted in removing the diseased and broken-down horn and applying an antiseptic dressing. Recovery occurred in fourteen days. Imminger described, under the title of "canker of the claw," a disease of the claw matrix accompanied by a tendency to necrosis. It seemed due to the presence of the bacillus of necrosis (Flügge), and should probably be included under the heading of panaritium.

V.—AMPUTATION OF THE CLAWS IN OXEN.

WHEN purulent or septic inflammation of the pedal-joint occurs in consequence of any of the above-described forms of panaritium, or of injury from foreign bodies, or when extensive necrosis attacks the phalanges, it is best to amputate the affected claw. Failing this, pain continues, and the animals die from decubitus, or from septicæmia. Even in the few cases which recover, the animal's general condition suffers very greatly before ankylosis of the joint becomes complete.

The experience of Harms and others encourages the performance of this operation, very little disturbance being caused, and recovery being comparatively rapid and complete.

Esser looks on amputation as the last resort in extensive necrosis of the phalanges. Provided the animal is still able to stand and has not suffered much in condition, he prefers conservative treatment.

Amputation may be effected either by exarticulation of the joint of the claw, or by resection of the os suffraginis. Harms prefers the first method, and lays great stress on the necessity for preserving the bulbs in order to ensure regeneration. The navicular bone is not removed.

The animal is cast, firmly fixed, and an Esmarch's bandage applied round the knee or fore-arm to prevent bleeding. Harms then removes the horn in grooves at either side, and on the lower surface of the claw, by means of a farrier's knife, the grooves thus made penetrating as far as the soft tissues and converging to one point. The coronary band is next separated, and the pedal bone removed along with the horn of the claw.

Eggeling first thins the horn over the posterior half of the outer wall and of the bulb. With a curved knife he makes an incision

starting from the interdigital space and keeping below the coronet, which exposes the pedal-joint, and takes the direction *a* to *b* to *c* (Fig. 582). The posterior end of the pedal bone (Fig. 582, *c*) being reached, the incision is continued downwards at a right angle (Fig. 582, *d*) to prevent injuring the navicular bone. By pressing the toe downwards and backwards whilst making this incision, the pedal-joint is opened, and the inner wall of the claw and interdigital ligaments may be cut through.

Möller repeatedly operated by this method, and recommends it.



FIG. 582.—An ox's claw. The letters *a* to *d* correspond to those in Fig. 581, and show the position of the pedal joint.

The greatest difficulty lies in so directing the knife as exactly to find the joint; but by bearing in mind the topographical relations given, and by using a very narrow, though not too weak a knife, the difficulty is much diminished. Cadiot proceeds as follows: Having thinned the horn over the seat of operation (Fig. 583), he discovers by palpation, and by moving the claw from side to side, the exact position of the joint, which lies about 1 inch below the coronet. This he opens with a curved knife similar to that used in excising the lateral cartilage (No. 4 in Fig. 569). Inserting the knife into the joint he makes the incision A, B, C (Fig. 583), dividing the horn, podophyllous tissue, lateral ligament of the joint, and the synovial

membrane. With a knife of opposite curvature the incision A, D is made, extending to the navicular bone. The claw is then disarticulated by plunging the knife into and through the joint and dividing the strong lateral ligament, &c., of the opposite side. The disarticulated portion is then removed by a straight cut, D, E.

From this point the procedure is similar in all cases.

After completely dividing the claw at the joint, loose or necrotic pieces of tissue are removed with scissors or knife. Any undermined parts and granulations are thoroughly disinfected, the articular carti-

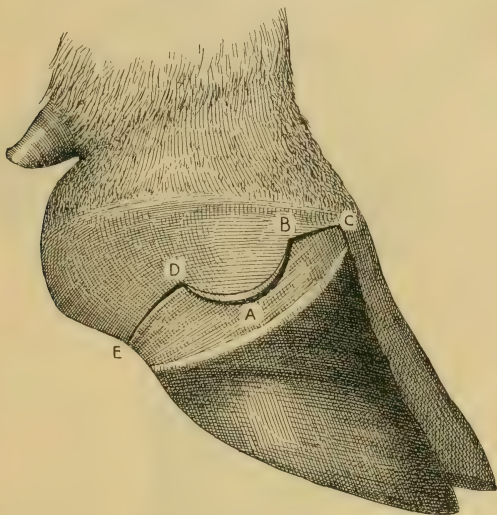


FIG. 583.—Disarticulation of the ox's claw. Primary incision.

lage scraped away from the coronet bone with a curette so as to produce a better granulating surface, the operation wound covered with a tampon soaked in tar, and a dressing extending above the fetlock-joint applied over all. The turns of the bandage are sewn together to keep the whole firm, and plenty of tar applied. This dressing is left in position for eight to ten days. On renewing it, granulations are generally discovered without suppuration having occurred. Recovery takes four to six weeks, the stump being covered by horn, secreted partly by the remaining portions of the coronary band, but chiefly by the bulbs of the heel. This growth is so perfect that animals may even be again turned out to grass.

After extensive necrosis of the os coronæ, or purulent inflammation of the coronet-joint, it may be necessary to remove the coronet bone along with the lower end of the os suffraginis. The animal is fastened as above described, and an Esmarch's bandage applied. The skin above the bulbs is then divided, either at the outer or anterior and posterior

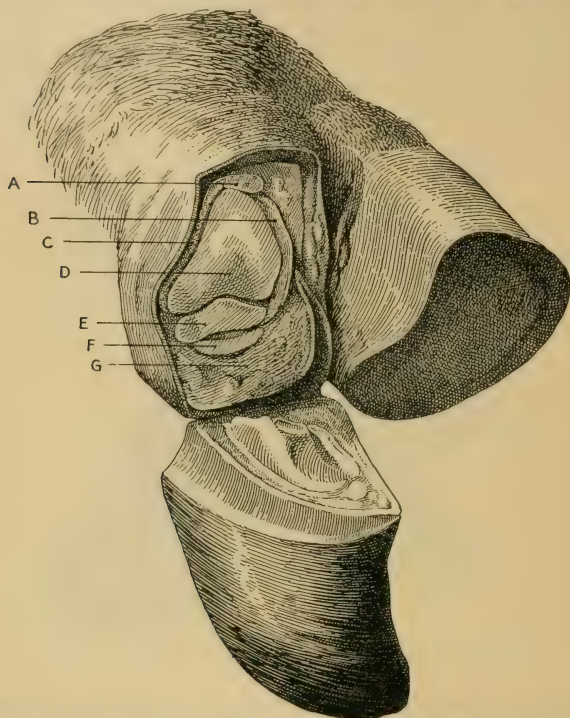


FIG. 584.—Disarticulation of the ox's claw. A, Extensor pedis tendon; B, internal lateral ligament; C, external lateral ligament; D, os coronæ, E, navicular bone; F, perforans tendon; G, plantar cushion.

faces of the phalanges, and separated from underlying structures, the os suffraginis being then sawn through in an oblique direction, from above downwards. After checking hæmorrhage, the point of operation is cleansed, disinfected, and the flaps of skin cut to shape and sutured under the stump. The above-described dressing may be left in position for eight to ten days, and seldom requires to be renewed more than two or three times before healing becomes complete.

VI.—ABNORMALITIES OF THE HORNY CLAW.

FISSURING, &c., of the horn, though very common in horses, is rare in oxen, and when occurring usually assumes the form of a crack extending from the bearing surface to the coronet of the outer claw in working oxen. The bearing surface of the claw usually shows contraction.

Disease of the substance of the horn is very rare, but the claw is sometimes so thin that the animal is useless for work on hard ground, on account of the sole continually being bruised and causing lameness.

Excessive growth of the toe is very common in stalled oxen. In consequence of the absence of wear the toe grows upwards, forming a kind of horn, while excessive weight is thrown on the bulbs, causing local bruises and pain. The animals avoid standing, eat less than usual, and lose condition. Shortening the toes relieves all these conditions.

Oxen with excessively turned-in or turned-out limbs necessarily have asymmetrical claws, just as similarly formed horses have irregularly shaped feet. Flat or dropped soles unfit working oxen for labour, on account of their becoming bruised.

A peculiar deformity consists in the point of one of the claws overlapping the other; the point of the inner claw often covers a considerable portion of the outer. The claws do not separate when the animals walk, and the opposed margins of the claws are bruised or the lateral ligaments of the joint are strained. The overlapping portions should be pared away.

VII.—FOOT-ROT IN SHEEP.

APART from foot-and-mouth disease, and from the contagious foot-rot of sheep dealt with in works on special pathology, chronic inflammation of the claws occurs in sheep, and is accompanied by chronic suppuration in the coronet or interdigital space. The horn at the coronet is loosened, the claw undermined, the lower phalanges and their ligaments sometimes become necrotic, and the pedal and coronet joints may be attacked, though they suffer less frequently than in cattle.

Causes. As a rule, foot-rot is produced by the same causes as panaritium. Continued standing on wet pastures or manure softens the horn of the claws, produces maceration of the skin around the coronet, and while it favours inflammation of the surface, leads by infection to suppuration, which extends to deeper-seated structures. Once the upper edge of the horn becomes loose, or inflammation

occurs in the interdigital space, recovery is impeded by the continuous movement of the parts and by fresh infection.

Symptoms and course. Attention being drawn to the disease by the accompanying lameness, the lining of the interdigital space is found to be red and swollen. Soon afterwards the surface becomes moist, a serous, and later a purulent, fluid being discharged. As a rule, inflammation is confined to the cutis, but the coronary edge of the horn and wall of the claw become loosened, the wall and the sole often undermined, and the horny claw may even be lost, unless proper treatment be immediately undertaken. In exceptional cases panaritium sets in, producing necrosis of the ligaments, tendons, and bones.

As swelling increases and the process extends, pain gradually becomes more acute. The animals lie continuously, or are absolutely unable to bear weight on the diseased foot, and suffer severely in condition. When the superficial attack receives no attention, the infection continues to extend, the disease becomes chronic, and may last for months.

Prognosis depends on the extent of local changes and on the degree of pain. Particular caution is required when the animals show great pain, cease to feed, and fall off in condition. The more the claws are deformed, the slighter the chance of recovery.

Treatment. The animal should be removed to a dry place, all moistening of the parts avoided, and when the horn is loosened and undermined, provision should be made for the escape of discharges. For this purpose loose horn should as far as possible be removed, and the diseased spot carefully cleansed. When the disease is superficial, it is sufficient to smear the parts with tar, carbolic acid or carbolic glycerin (5 to 10 per cent.), or to powder the diseased surface with iodoform or similar disinfectant. Troublesome granulations are checked by astringents like sulphate of copper, alum, &c., though the cause of such growths, which often consist of dead masses of tissue or projecting pieces of horn, must be removed.

In deeper-seated disease, the treatment is similar to that in panaritium. Fixing the claws by a dressing or piece of wood placed in the interdigital space, and fastened by string, will also be found of service.

In sheep, the horn of the wall and sole sometimes grows irregularly, or becomes too long, leading to suppuration under the sole. The treatment consists in shortening the wall, thinning the sole, and giving a dry bed. Further treatment is guided by the same principles as in inflammation of the horse's hoof.

Finally, a grey fatty material sometimes accumulates in considerable quantity in the peculiar glands above the claws in sheep, and is discharged as a worm-shaped mass when the parts are pressed, or the claws forced into contact. The condition is seldom of practical importance, but is sometimes looked on by shepherds as the cause of other painful conditions. Under some circumstances, retention of this secretion may certainly lead to inflammation of the sac. A painful swelling then appears at the front of the interdigital space, and discharges more or less puriform fluid if compressed. To effect a cure, it is usually sufficient repeatedly to empty the sac by pressure.

H. DISEASES OF THE CLAWS IN CARNIVORA.

The claws surround the last phalanx, which, in carnivora, is covered by the claw matrix, just as is the *os pedis* in other animals. The third phalanx of the dog lies almost at a right angle to the second, with which it articulates, and just in front of the joint shows a ring-shaped depression, to receive the base of the claw. The portion of cutis which serves as matrix to the claw shows a circular thickening, the coronary band, which secretes the horn of the claw. The matrix covers the anterior portion of the third phalanx, and exhibits small furrows or *laminæ*. The volar surface of the third phalanx is covered with a material homologous with the sensitive sole. The claw is formed by two horny plates, lying closely together, and enclosing a space. They are fixed by their base into the furrow of the bone. Two elastic ligaments, which start from the upper end of the second phalanx, and run to the upper surface of the furrow, serve to lift the claw, and prevent it being excessively worn away. The claw does not touch the ground when weight is placed on the foot, and the weight of the body is therefore sustained by the pads of the sole and toes. These are rounded masses of connective tissue, containing elastic fibres and fatty tissue; they are provided with a strong epidermis, and are connected by ligaments with the phalanges. They are black in colour, contain neither hair follicles nor sebaceous glands, but are provided with numerous sudoriparous glands.

I.—GROWING-IN OF THE CLAWS (INCARNATIO UNGUIS). DISLOCATION OF THE CLAWS. CHRONIC INFLAMMATION OF THE CLAW MATRIX. LOSS OF THE CLAWS.

IN cats and dogs, the dew-claw, which does not touch the ground, and therefore is not worn away, sometimes becomes abnormally long, and assumes a curved form. Its point then enters its corresponding pad, produces great pain and lameness, and occasionally suppuration in and around the pad. **Treatment** consists in shortening the claw by means of forceps or strong scissors, care being taken

not to remove too much and thus injure the last joint of the toe. In the same way, the claws of cage-birds often grow to an excessive degree, and require to be shortened.

In dogs, the claw and its matrix are sometimes violently torn off. Sometimes only a portion of the plate of horn is separated from the last joint of the toe; sometimes the greater part of it is gone so that the claw only remains attached to the sensitive structures by a shred; sometimes it is completely lost. The accident is commonest in large dogs, in consequence of the claw being caught in a cord, net, or similar object, is painful, and always causes lameness. Pain is especially severe if the claw remain hanging, because it then comes in contact with the ground at each step; its complete loss is less painful. Careful examination at once detects the character of the accident. If only a small part of the horny plate be lost, the parts may reunite, otherwise it is best entirely to remove the claw. It can be snipped off with scissors; if, however, the last joint of the toe be also injured or otherwise diseased, and if extensive change have taken place in the matrix, it is better to amputate the third phalanx by exarticulation at the last joint of the toe, which lies a little behind or above the upper edge of the nail. As a rule, strong scissors are sufficient, and by making one rapid cut the operation is rendered less painful. In the same way, a claw which is nearly separated from its matrix may be removed. No particular after-treatment is required, the wound merely requiring to be kept clean; some dogs will bear a dressing, others will not. A dressing is most useful when the claw alone is removed, and the third joint of the toe left. If needful, the wound or claw matrix may be smeared with tar.

Loss of the claw. Chronic inflammation of the claw matrix, gradually leading to complete loss of the claw, is not uncommon in large dogs. Kutzbach described it as panaritium. Where it originates in the coronary band, the horn of the claw is thickened and degenerated. Sometimes, however, the "sole" becomes diseased, and then nothing abnormal is seen on the claw, but the matrix, and particularly the lower surface of the claw, discharges a turbid fluid. Horn production is in abeyance, and, as a consequence, the claw is more or less loosened. The changes in the matrix are sometimes so slight that nothing whatever unusual can be detected with the naked eye; in others, chronic inflammation of the sensitive "sole" exists, leading to suppuration or ulceration. The claw is thus loosened, and when the process extends to the other portions of the horn-secreting membrane, is completely lost. The process often affects the subcutis, or even the periosteum, causing the toe to become three to four times

its ordinary thickness. The proliferating tissue contains little yellow points or yellowish-red granulations.

The exact cause of this disease seems still open to discussion, though it closely resembles onychia maligna in man. In some cases herpes or eczema of the neighbouring skin had extended to the matrix of the claw, but in others no cause whatever could be discovered. Kutzner has shown that the disease is not due to want of cleanliness. It often attacks several feet, generally affecting the dew-claws, so that it might be viewed as due to disturbance of nutrition. Large dogs in the prime of life are the commonest subjects. It is most frequently seen in autumn and winter in dogs which live near the seaside and often go into the water. Frick reports the disease as quite common in Hanover; he treats it by operation. Rabe states that it is due to a microbe, the *Cladothrix canis*.

The animal walks with a short, painful step, lies down a great deal, and has difficulty in standing. Local examination soon shows the character of the disease. At first the "coronet" is only reddened and swollen, but exudation soon occurs, and after some time small, bluish, prominent spots develop, which later suppurate and may lead to sinus formation. The disease often persists, with remissions and exacerbations, for a long time, gradually extending to the deeper-seated tissues.

As a rule, the process cannot be checked, but leads to complete loss of the claw, though Frick has had occasional success by early injection of iodine tincture into the coronary band, and therefore the prognosis principally depends on the number of diseased claws. Where confined to single claws, amputation at the last joint offers the most satisfactory results, otherwise the loose claw should be removed, the matrix cleansed and disinfected, smeared with tar or other disinfectant, and a bandage applied. Kutzbach recommends liquor arsenicalis internally, and locally pencilling with nitrate of silver. Attempts to save the diseased claw generally fail. In this respect the condition shows a great resemblance to canker and certain forms of chronic laminitis in horses. Unlike canker, however, it shows no tendency to produce vegetations from the matrix of the claw.

II.—BRUISES AND WOUNDS OF THE PADS OF THE SOLE AND TOE.

THE carpal-pads of carnivora do not touch the ground during movement, and the body-weight is sustained by those of the sole and toes. Continued exercise on rough, hard ground may wear these

away, and cause the animal to show pain when walking, a condition most commonly seen in sporting-dogs during the winter. In addition, the pads may be injured by treading on sharp objects, like pieces of glass, which produce more or less serious wounds, or by the animal stepping in caustic chemical substances like quicklime, acids, &c.

The naturally black colour of the pad is lost when its epidermis is excessively worn, and the surface then appears more or less red, painful on pressure, and abnormally warm. The animal rests a great deal, and when on rough ground, takes short steps, exhibits pain, and has a desire to lick the pads. Should the epidermis be completely worn away at any point, suppuration, or even necrosis of the pad may occur. Severe lameness results, appetite is lost, and fever sets in. Wounds of the pad generally suppurate, and frequently show limited necrosis.

The prognosis is generally favourable when rest can be given and necrosis is not extensive. In some cases the phalangeal joints become the seat of purulent inflammation, though such a result is rare.

Treatment. When the pads are sore, the animal should be rested and placed on a dry, clean bed. In eight to fourteen days the epidermis will have grown again. If the parts be wounded or suppurating, the undermined epidermis is carefully removed with scissors, the wound cleansed, and any foreign body removed. Abscesses, when present, are freely laid open. Further treatment is scarcely desirable, both because the animal resists, and because it keeps the wound thoroughly clean by licking the surface. A surgical dressing is seldom needed unless granulation appears too active or cicatrisation is checked by the animal's interference. A dressing may then be applied, or the diseased spot may be smeared with some bitter-tasting substance, like aloes, which repels the animal, and at the same time assists healing. Severe itching is sometimes removed by pencilling with cocaine solution, but precautions are required against absorption of the drug.

Frequently, small cysts form between the toes, causing lameness and considerable suffering. One foot or simultaneously several feet may be affected. Surface applications are of little use in these cases, and the only effective treatment consists in removal of the cyst-wall and contents, followed by the application of an antiseptic dressing.

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